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CIS

ENERGY CONSERVATION STRATEGY FOR THE 1980'S

HEARING

BEFORE THE

SUBCOMMITTEE ON
ENERGY, NUCLEAR PROLIFERATION, AND
GOVERNMENT PROCESSES

OF THE

COMMITTEE ON
GOVERNMENTAL AFFAIRS
UNITED STATES SENATE

NINETY-SEVENTH CONGRESS

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CONTENTS

Page

Opening statements:
- Senator Percy — 1
- Senator Glenn — 2
- Senator Durenberger — 9
- Senator Levin — 27

WITNESSES

TUESDAY, JULY 21, 1981

Joseph J. Tribble, Assistant Secretary for Conservation and Renewable Energy, Department of Energy, accompanied by J. Hunter Chiles III, Director, Office of Policy, Planning and Analysis, DOE — 6

Linda Parke Gallagher, executive director, Alliance to Save Energy; S. David Freeman, Board of Directors, Tennessee Valley Authority; Robert H. Williams, senior research physicist, Center for Energy and Environmental Studies, Princeton University — 47

Alphabetical list of witnesses:
- Chiles, J. Hunter:
  - Testimony — 6
  - Additional information requested by Senator Glenn — 33
- Freeman, S. David:
  - Testimony — 47
  - Prepared statement — 155
  - Responses to written questions submitted by Senator Percy — 159
- Gallagher, Linda Parke:
  - Testimony — 47
  - Prepared statement — 54
  - Responses to written questions submitted by Senator Percy — 68
- Tribble, Joseph J.:
  - Testimony — 6
  - Responses to prehearing questions — 35
  - Responses to written questions submitted by:
    - Senator Percy — 41
    - Senator Glenn — 46
    - Senator Jackson — 46
- Williams, Robert H.:
  - Testimony — 47
  - Prepared statement — 71
  - Responses to written questions submitted by Senator Percy — 118

Additional information submitted for the record:
- Statement submitted by Senator Glenn concerning industrial energy conservation — 33
- Reports by the Lawrence Berkeley Laboratory, University of California:
  - "Accelerating the Building Sector's Sluggish Response to Rising Energy Prices," April 8, 1981 — 161
  - "Building Energy Labels," June 18, 1981 — 193

ENERGY CONSERVATION STRATEGY FOR THE 1980'S

TUESDAY, JULY 21, 1981

U.S. SENATE,
SUBCOMMITTEE ON ENERGY, NUCLEAR
PROLIFERATION, AND GOVERNMENT PROCESSES,
COMMITTEE ON GOVERNMENTAL AFFAIRS,
Washington, D.C.

The subcommittee met at 9:08 a.m., in room 3302, Dirksen Senate Office Building, Hon. Charles Percy (chairman of the subcommittee) presiding.

Present: Senators Percy, Durenberger, Glenn, and Levin.

OPENING STATEMENT OF SENATOR PERCY

Senator PERCY. I am pleased to welcome all of you here today for this hearing of the Subcommittee on Energy, Nuclear Proliferation, and Government Processes of the Governmental Affairs Committee.

This morning's hearing is on conservation strategy for the 1980's, in light of the recent release of the Reagan administration's national energy policy plan.

For several months, I have called upon President Reagan and Energy Secretary Edwards to articulate a strong new energy policy which takes into account the current state of our economy and the national security implications of our energy vulnerability. I am pleased that, with last Friday's release of the national energy policy plan, we do have such a policy statement. I must commend the authors of this plan for producing such a clear and readable document in a short period of time, and I am sure it will give added focus not just to this hearing, but to the entire spectrum of energy issues of concern to the Congress and the American people.

In general, I agree with most of this new policy statement and what it has to say. I find its discussion of energy security issues to be particularly good, and I am heartened that we finally have a regime at the Energy Department that has the right idea about how to prepare for oil shortages.

Perhaps the most controversial statement in this plan is that "achieving a low level of U.S. oil imports at any cost is not a major criterion for the Nation's energy security and economic health." While I accept the point the administration is trying to make—that we should not embark on wastefully expesive new programs to replace oil with other fuels—I do feel we must continue to do all we can to reduce what stiil is a very dangerous dependence on imported oil.

I think the American people are willing to pay a slight premium for homegrown fuel—or to invest a little extra in conservation—to increase the odds that we will never again see long gas lines, another doubling or tripling of crude oil prices, or another debilitating round of inflation. I also think our allies throughout the world would be delighted to see us continue to cut our oil imports at the rate we have over the past 3 years. While the United States can never be, in any real sense, energy "independent"—the situation of our allies is too precarious to let us ever think in these terms—the world will be a safer and more prosperous place if we continue to cut back on our oil imports.

The national energy policy plan projects that, by 1990, our level of oil imports will be barely lower than they are today. I think that projection is far too pessimistic. Conservation has played an important role—perhaps the leading role—in reducing imports over the past few years. I expect it will be equally important in the years ahead as the American people—prompted by the President's decontrol actions—continue to buy more energy-efficient cars, insulate their homes, and improve the energy-efficiency of their businesses. If it isn't, we have some serious work to do—I do not think the American economy can afford another decade of our spending $75 billion or more every year on imported oil.

While the energy marketplace can benefit from large doses of deregulation, we still have to apply some commonsense in knowing where the market has its limits.

As long as natural gas prices remain below their long-term free-market level, for example, we will still need extra incentives to persuade consumers that conservation is the right thing to do. Likewise, with interest rates high for small businesses, and with so many low-income households unable to afford energy-efficient houses or automobiles, the free market will not always produce as much investment in conservation as we would like.

I look forward to discussing these and other related issues at this morning's hearing. As our lead witness today, we are pleased to have the Honorable Joseph Tribble, the Assistant Secretary for Conservation and Renewable Energy at the Department of Energy. This is Mr. Tribble's first appearance before a congressional committee since his confirmation. Accompanying Mr. Tribble is Mr. J. Hunter Chiles, III, Director of the Office of Policy, Planning, and Evaluation. Following Mr. Tribble will be an expert panel composed of Ms. Linda Parke Gallagher, the executive director of the Alliance to Save Energy, Prof. Robert Williams of Princeton University, and the Honorable David Freeman of the Tennessee Valley Authority.

We are very pleased to have our witnesses appear now at the table, starting with the Honorable Secretary Joseph Tribble.

Senator Glenn, we are very pleased to have you here this morning. I understand you have a statement. We would appreciate your giving that statement.

OPENING STATEMENT OF SENATOR GLENN

Senator GLENN. Thank you, Mr. Chairman.

I would like to join you in welcoming the participants in today's hearing on the Nation's energy conservation strategy for the 1980's, as well as some discussion of the administration's national energy policy plan, NEP–III.

NEP–III, billed as "a radical departure from the prevailing policy instituted after the first shock of rapid oil price increases in 1973 and 1974," and the Department of Energy's conservation strategy places increased reliance on the free market approach. By itself, that approach is not objectionable. In the past, we have too often been remiss in not recognizing that the free market, if allowed to function properly, is an efficient allocator of energy resources. Furthermore, free markets permit prices and resource allocations to be determined by impersonal forces rather than by a few special interest groups.

I am also pleased that NEP–III recognizes that the truly needy require protection from the ever-increasing spiral of energy prices—price increases that will help to stimulate production on the supply side and reduce consumption on the demand side. It remains to be seen, however, how much protection the administration will offer for these needy people.

I think this administration is remiss, however, if it truly thinks that oil decontrol and reduction in regulations define a free market in energy. I believe, and I think that I will be backed up on this by members of the panel later this morning, that we have a considerable distance to go before we get to a free energy market.

First, even though oil is decontrolled, and pegged to OPEC prices, many experts place the true cost of imported oil, in the margin, $10 or more per barrel higher than the world price if we take account of the cost of vulnerability and the things we have to do in that area. In addition, natural gas and electricity prices are both pegged at rates lower than replacement cost.

Second, a free market requires that buyers and sellers have access to information. I think most of us would agree, however, that good energy information is hard to come by, and that what is available is often too technical to be of much use to the average consumer.

Third, I would bring up the subject of Government tax and expenditure policies toward energy supply and energy conservation or efficiency. Rather than putting investments where they will do the most good, Government support is strongly tilted toward additional energy supply as opposed to increased energy efficiency.

In her testimony to be given later this morning, Ms. Gallagher, of the Alliance to Save Energy, estimates that energy supply measures receive about 12 times more support than energy conservation measures—a tilt which this administration has maintained in spite of the appearance of several recent books, studies, and monographs which reiterate again and again that energy conservation represents an untapped energy resource that is often the cheapest, safest, most environmentally sound, short-term solution to our energy difficulties. As Dr. Ross and Dr. Williams, who we shall be hearing from later, state in their provocative book, "Our Energy: Regaining Control,"

> * * * the opportunities for improving energy efficiency are so great that total energy demand could actually decrease for several decades without adversely affecting the economy.

This is a recurring theme which has appeared in recent studies by the Harvard Business School Energy Project, the Ford Foundation and

Resources for the Future, the National Academy of Sciences, and others.

I want to emphasize that I am talking about energy conservation in terms of increasing energy efficiency, not in terms of deprivation. Conservation does not just mean "being cold in the winter, hot in summer," as President Reagan has been quoted as saying recently. Rather, it means deriving more productivity from a given input of energy—more bang for the Btu, so to speak.

Finally, I close by noting what I consider to be the most disturbing aspect of this administration's energy policy. That is its attitude toward energy R. & D. The administration says that if it is worth doing, the market will do it, and the Government only needs to support long-term R. & D. I believe that, regardless of the time frame, we need to be doing the R. & D. in those areas which offer the cost-effective means of developing future supplies of energy—whether they be in the form of actual production or via savings through conservation.

For over 3 years, I worked and jawboned and cajoled the Carter administration, along with a few other people here on the Hill, to increase its funding in energy R. & D. in the areas of solar and renewables and conservation. My goal was to have this R. & D. funded at a level which would represent at least 1 percent of the cost of our annual oil import bill— just 1 percent out of that $80 billion. We finally had this amount and a bit more in the fiscal year 1982 budget request as submitted in January—about $777 millon in solar and renewable energy R. & D., including energy storage—areas I think are very important—and a little over $300 million energy conservation R. & D.

And then what happened?

Well, at a time when the Pentagon was asking for billions more for defense—a goodly portion of which was justified on the grounds of maintaining our access to oil supplies—the new administration cut $484 million, or 62 percent from solar and renewable R. & D., and $216 million, or 71 percent, from energy conservation R. & D. for fiscal year 1982. This is as pound-foolish a move as I have ever seen since I have been on Capitol Hill.

If we ever hope in the future to achieve energy independence or at least lessened dependence on oil and gas, it is going to come not because we sat around wringing our hands with our grandchildren hoping for the best, but because we had the vision and foresight to do the energy R. & D. today that can give us that potential for the future. I call on the administration to provide this vision and ask that it recall the wise words from chapter 29 of the Book of Proverbs, where it says: "Where there is no vision, the people perish."

I think we can apply that today to our energy situation, because I don't see that we have the vision today to do the R. & D. to give us the energy independence we can have in the future. I think it is that simple. We are chopping and hacking away at our energy R. & D. budget, our one hope of getting energy independence in the future. We may be pennywise in this year's budget, but we are just pound-foolish for the future. I think it is just that simple.

Thank you, Mr. Chairman.

Senator **Percy**. I think we have seen an evidence of it both in Illinois and Ohio, two of the major coal gasification projects, where a consortium company of standing has simply abandoned any effort to go forward. There is no way they can justify it to the stockholders on a totally free enterprise system. They compare it to the Manhattan project or synthetic rubber. We never would have had those projects if we had not decided they were in the national interest. The same could be said for the space program.

Senator **Glenn**. The administration action that gets me—and I note you and I are going to be the whole hearing this morning if we keep arguing with each other, and I don't want that [laughter]—the one that gets me more than anything else is cutting funding for research on electrical energy storage. If I had one energy wish for my country that I could have before this hearing ends this morning, it would be that we would have better electrical energy storage.

I can't pick up a science magazine or any publication in this area that doesn't show a windmill churning or devices for wave power, photovoltaics, and so on; all sorts of ways of converting solar energy to electricity. We talk about electric cars to take care of the 92 percent of the driving that occurs within 20 miles from our homes. If we let the Japanese beat us to that we will not be asking Detroit for new cars; we will be making Detroit a scenic park. [Laughter.] That doesn't exaggerate the situation very much. Yet we cut back on funding for electrical energy storage that will help us make the breakthrough we need to make widespread solar energy and electrical usage a reality.

Economic and practical energy storage would let us store great amounts of energy and lessen our dependence on imported oil. We are cutting back on that kind of R. & D. and saying the private market will do it. It is a little like saying the private market should have taken care of the Manhattan project.

I just think when we cut back on R. & D. we are slitting our own throats as far as the long-term energy future of this country goes. I think it is tragic.

Thank you, Mr. Chairman.

Senator **Percy**. With those provocative comments, we have set the stage for a fine hearing.

I do want to say that our first witness does not come here without a solid record of achievement. I commend the administration for selecting you, Mr. Tribble. The work you did as energy coordinator in the Union Campe Corp. in Savannah when you racked up a record of reducing energy consumption by 40 percent is, I think, one of the outstanding records in the country. I know that you bring top-level management skills to the important position you have at DOE. I do wish to commend you and the Department for the close work that you have done with our staff, under the direction of Bill Strauss, who is a former DOE executive, in preparing for these hearings. I feel quite confident we will be working in the years ahead to develop an effective conservation strategy for the country.

Mr. Chiles, even though you will not be testifying, as I understand it, you will be available for questions as Director of the Office of Policy, Planning and Analysis, who oversaw the preparation of the Reagan administration's national energy policy plan. Your presence here this morning is very much appreciated.

Mr. **Chiles**. Thank you.

Senator **Percy**. Secretary Tribble.

TESTIMONY OF JOSEPH J. TRIBBLE, ASSISTANT SECRETARY FOR CONSERVATION AND RENEWABLE ENERGY, DEPARTMENT OF ENERGY, ACCOMPANIED BY J. HUNTER CHILES III, DIRECTOR, OFFICE OF POLICY, PLANNING AND ANALYSIS, DEPARTMENT OF ENERGY

Mr. TRIBBLE. Thank you, Mr. Chairman, Senator Glenn.

On behalf of the Department of Energy, I welcome this opportunity to address the topic of conservation strategy for the 1980's.

First, I would like to comment on recent progress in energy conservation in the United States, then turn to a discussion of the strategy being followed in conducting Department of Energy programs to encourage this trend to continue.

In order to place recent progress in energy conservation in the appropriate context, perhaps we should review the situation as it existed in 1972. Prior to that time virtually all forms of energy were inexpensive. Most dwelling units had been constructed with little consideration being given to energy utilization efficiency. Office buildings had been constructed with vast expanses of glass. Appearance and aesthetics were much more important than energy efficiency. Our entire industrial complex was designed and built, in most instances, on the basis of energy being a small portion of manufacturing costs. The automobiles we drove were designed with comfort and appearance in mind, and fuel economy was a secondary consideration. We were a Nation whose standard of living was based to a large extent on inexpensive energy. The events of 1973 brought us abruptly to the realization that inexpensive energy was a luxury that we had taken for granted.

When the price of oil doubled, and then quadrupled, we began to take measures to control energy costs. In industry the first things that were done were the so-called housekeeping measures. We began to close up buildings, stop steam leaks, install insulation, improve maintenance on energy-using equipment and look for ways in which we could reduce energy consumption per unit of production. The next phase of this activity was to install heat exchange equipment and give consideration to capital expenditures that would further reduce energy costs. As the costs of energy continued to escalate, more energy saving capital projects came within the return on investment sought by industry, and investment of this type increased. Tax credits helped to stimulate it further. For further improvements, industry has been turning to replacement of plant and equipment and to changes in process. This is an ongoing process that we expect to continue over a longer time period. The President's proposed tax cuts and revised depreciation schedules will greatly encourage these needed investments.

In the transportation sector, as the price of gasoline continued to rise and transportation costs began to eat into disposable income, we came to the realization that there were things that we would have to do. We began to take shorter vacation trips and also began to look for automobiles with better fuel economy.

In our homes we were reluctant to change our habits. However, as the cost of energy continued to rise we began to do such things as raise the settings of our thermostats in the summertime and lower them in the winter. We also began to look for ways in which we could make our homes more energy efficient by making investments in additional insulation, weather stripping, and storm windows. Tax credits further encourage these trends. In almost all of these instances the steps we took to reduce energy consumption were in response to the increased cost of energy and the anticipated further increase in its cost.

In order for us to see the effect that these measures have had over time, let's compare the energy efficiency in 1972 with that of 1979, the latest year in which the figures are available. In the 10 most energy intensive industries, the figures are as follows. I mention just a few of these, the reporting industries, and then the number will relate to the percent improvement of 1979 over 1972. The source of these numbers is the 1979 Annual Report to the Congress and the President on the Industrial Energy Efficiency Improvement Program.

In the chemicals and allied products industry, the improvement has been 22.1 percent; in primary metals, 7.8; petroleum and coal products, 14.7; stone, clay, and glass products, 12.9; paper and allied products, 16.9; food and kindred products, 15.3; fabricated metals, 21.5; transportation equipment, 23.4; machinery, except electrical, 24.7; and textile mill products, 17.7.

In the transportation sector, the average mileage obtained in 1972 was 13.5 miles per gallon for automobiles. The 1980 estimate for this figure is 15.1 miles per gallon. This improvement was made despite the adverse effects on fuel economy of some of the pollution controls.

There are two measures of the reduction of energy use in buildings. One is the annual direct energy use per household. In 1972 this figure was 166 million Btu's per household. In 1980 the number was down to 131 million Btu's per household. The other statistic is the annual direct energy use per square foot in commercial buildings. In 1972 it was 305,000 Btu's per square foot and in 1980 it was down to 247,000 Btu's per square foot.

In virtually all of these instances where energy utilization efficiency was improved it was in response to the increased cost of energy or the anticipated escalation of its cost. The Reagan administration recognizes this fact and believes that, in most instances, the free market action resulting from price decontrol will cause conservation to be effected where it is most cost effective. There are, however, appropriate roles for the Department of Energy to play in bringing about further improvement in energy utilization efficiency in the 1980's.

In the industrial sector we believe that the free market and existing tax credits, in conjunction with the proposed revised tax structure, will be adequate incentive for industry to take the conservation measures that are most appropriate. The economies that can be obtained through the cogeneration of electric power and process heat should be recognized by industry; there is a strong role here for the industrial trade associations.

The Public Utility Regulatory Policy Act of 1978 encourages cogeneration and the production of electric power from small power facilities by removing institutional barriers to cogeneration. The technology for cogeneration is not new and we feel that there is little need for research and development in this field. The Department of Energy rule is primarily one of bringing to the attention of industry the advantages that are available through cogeneration. In the transportation sector the higher costs of energy are causing the automobile manufacturers to do research and to manufacture automobiles with better fuel economy. Competition for the market, both domestic and foreign, should provide ample incentive for this process to be continued.

At the same time, in the Department of Energy, we have fostered research and development aimed at bringing into the market an electric vehicle and a hybrid vehicle. Great strides have been made in the development of the electric vehicle in recent years and in our judgment this technology shows great promise. Not only does the use of electrically driven vehicles reduce the demand for gasoline, but in most instances the batteries for these vehicles will be recharged during off-peak hours which will help level the load and improve the efficiency of the utilities. We believe that the gas turbine has potential applicability to trucks and buses and we are doing research, particularly in ceramics, to develop materials and components that will enable gas turbines to operate at higher temperatures and thereby at higher efficiencies.

Commercial and residential buildings are perhaps the most difficult segments of our economy to address from the standpoint of improving energy utilization efficiency. There are some 80 million dwelling units, most of which were built when energy was inexpensive and when little attention was paid to energy consumption. The retirement rate of these dwelling units is relatively low and they will be in use for many years. We need therefore to develop means by which we can make retrofit investments that will be effective and relatively inexpensive.

The private sector—property owners and businesses—of course have incentives to retrofit buildings to save money, and the private sector will pay for the bulk of these investments. In addition, the Department of Energy has been and will be involved in research and development in determining which items are most cost effective. Attention will be paid to roofing systems, to windows and to lighting so that we will be able to pass to the private sector information regarding the effect of these components on the energy efficiency of buildings in various climates.

It has been found that as infiltration is reduced the problem of stale air arises. It is our intent to do research into this area and review the standards that have historically been used for the number of air changes per unit of time. We are also investigating means by which these necessary changes can be accomplished with a minimum loss of energy. We will continue to make this kind of information, as well as the result of our research, available to the public through information dissemination programs.

In summary, it seems obvious that the American people have been taking the steps necessary to conserve energy—to use it more efficiently in the face of higher prices. The primary means available to the Government to encourage conservation is to establish realistic energy pricing policies. Consequently, the President decontrolled oil prices shortly after taking office, confirming the administration's commitment to realistic energy pricing policy. Importantly, Congress now seems to appreciate the fact that realistic pricing policy is an essential part of an effective energy conservation strategy. The Federal budget cannot possibly pay for all the energy conservation needed in the country. Consequently, it is our job in DOE to see that the American people face market signals that encourage conservation in their homes, farms, factories, offices, and transportation systems, and to focus limited Federal financing on research and development efforts and to provide information which complements the market.

Mr. Chairman, this concludes my opening statement.

Senator PERCY. I thank you very much indeed, Secretary Tribble. I know that the statement came right from your own heart and your own experience and knowledge, and it shows it.

Senator Durenberger has joined us. Do you have any opening statement you would like to make or insert in the record?

OPENING STATEMENT OF SENATOR DURENBERGER

Senator DURENBEREG. I do on both accounts, Mr. Chairman. I just want to compliment you on your sense of timing—the coincidence of this hearing with the release of the national energy policy plan III. I tried to do that in the Subcommittee on Intergovernmental Relations a few weeks ago—to time a hearing on State implementation of the national standards on clean air with what I thought was going to be the release of the EPA's recommendations on a new bill. Apparently somebody leaked it to Henry Waxman first, so we still don't have a bill. I am having my hearings without a bill. So I compliment you on your sense of timing.

I have a more-to-the-point statement that I would appreciate having made a part of the record.

Senator PERCY. It will be made a part of the record at this point.

[The statement follows:]

PREPARED STATEMENT OF SENATOR DAVE DURENBERGER

Mr. Chairman, I would like to begin by complimenting you on your sense of timing. This hearing coincides with the release of the Administration's new National Energy Policy Plan. This plan has important implications for the future of energy conservation in our nation. To my reading, and I have read the Plan, these implications appear to be largely adverse. So, Mr. Chairman, I welcome the opportunity of this hearing to explore the conservation strategy of this Administration.

In a nutshell NEP III argues that we put the "marketplace" at the heart of our energy policy. The marketplace begins with the decontrol of crude oil prices. It also includes the decontrol of natural gas prices. Finally, it proposes "decontrol" of synfuels, conservation and renewables—"decontrol" in the sense that we abolish the subsidies that promote near term commercialization of alternative energy resources.

NEP III argues that this marketplace approach will be a great boost for energy conservation. The Administration points to the large efficiency improvements in every sector of our economy which have been realized since the Iranian disruption of 1979 and President Carter's decision to begin decontrol of oil. They also point to the slight decrease in oil prices that has been registered since President Reagan's decision to accomplish decontrol immediately.

Mr. Chairman, I supported decontrol of crude oil prices. After a decade of energy uncertainties it was clear to me that price controls on domestic crude oil were no more than a form of subsidy for petroleum imports. And dependence on imports is our most important national problem. However, my support for decontrol was not based on the belief that there was an energy "marketplace" just around the corner that would protect us from energy crises in the future.

In fact, I believe that the energy marketplace that this Administration would have us rely on is no more than the monopoly interest of a foreign nation.

It is true that Americans are saving energy at unprecedented rates. And it is true that prices have declined slightly in the last few months. But Americans are saving that energy by driving small cars that our auto industry was unprepared to manufacture. And the price decrease was created not so much by our conservation as by the extraordinary production of one foreign oil producer. Let, me take these examples one at a time to illustrate the folly of depending on the energy marketplace that exists today.

NEP III points to a 13 percent reduction in expected oil consumption by the transportation sector as a result of higher prices. There wouldn't be any problem with that number, if Americans were saving it in American cars. But they are not. They are driving imports and Detroit is practically belly up because of the price increases that occurred in 1979. Why were foreign manufacturers ready with small cars when the disruption hit? It was not because their nations had relied entirely on an energy marketplace for the past decade, but rather it was because their governments had acted to intervene in the marketplace in a decisive way—to impose a gasoline tax.

The second issue—the issue of who exactly controls the marketplace—is just as serious. The Administration would like to believe that the consumer is in control—that the price reduction of the last few months reflects the decision of consumers to conserve. That is just factually not the case. And it is important that we not misread the facts, here.

The price decreases of early 1981 are not due to immediate decontrol of American domestic prices. That decision led to a sharp rise in prices in the early months of this year. The price rollback is due to the glut on the world oil market and that glut has been created through the conscious actions of one actor—Saudi Arabia.

The Saudis have a lot of oil. Enough to last well into the next century at current production rates. They want to sell that oil and would thus be concerned if our conservation efforts were too successful. They want us to go on being dependent. When the world market premium was $40 per barrel, a wide range of alternatives appeared to be competitive. So the Saudis used their control over the marginal barrel of production to force their partners of OPEC to accept a price reduction. This reduction is designed for no other purpose than to continue our dependence on imported oil. If this monopoly producer has the power to force the price down when it is in their interest to do so, it stands to reason that they can use the same power to move the price upward. My complaint with NEP III is that we put the whole of our energy policy at the mercy of Saudi interests when we rely on the energy "marketplace." This it seems to me an unwise policy, not because the Saudis are not good partners in the international community and not because I am concerned for the stability of that society, but simply because we lose control over our security, the health of our economy and the health and welfare of our citizens by doing so.

I think we can do better than rely on the marketplace. Thank you, Mr. Chairman.

Senator PERCY. I would like, first, Mr. Tribble, to explore an area with you that bears on one of the statements that you made in your opening statement and that I referred to in my comments; namely, that the national energy policy plan asserts that achieving a low level of U.S. oil imports at any cost is not a major criterion for the Nation's energy security and economic health.

Until we are no longer vulnerable to oil supply disruptions or price hikes, I believe we simply must continue to do all we can to reduce the level of our imports. I would think that would be a part of our overall policy.

Perhaps in light of that sentence, however, you could restate whether oil import reduction is a high priority goal of this administration and how, therefore, we should interpret the sentence that I quoted.

Mr. TRIBBLE. Yes, Senator. We certainly agree that this is a high priority item.

The Office of Conservation and Renewables has two primary objectives. One is to improve the efficiency of energy utilization throughout the Nation. The other is to increase the amount of energy that we obtain from renewable sources. Both of these are aimed at reducing the importation of foreign oil. We certainly agree that this is a major factor.

Senator PERCY. Mr. Chiles, as long as you did oversee the preparation of the Reagan administration's national energy policy plan, would you have any further comment?

Mr. CHILES. Yes, Senator. I think it is important to recognize what exactly those words do mean. The words do not mean that we see the level of imports as being totally immaterial. What we are saying is that the important issue here is how vulnerable this country is to supply disruption worldwide.

What we are trying to suggest here is that the level of imports alone will not solve the vulnerability problem. It obviously is part of the solution. But other solutions to the vulnerability problem are such things as strategic petroleum reserve, renewable resources, synthetic fuels, even use of more electricity from coal and nuclear power. Anything that will reduce our vulnerability is a goal of the Federal Government now as we see it.

I might point out also that we are now in a world context when we look at our oil problem. Since we have agreements with our trading partners—Japan, Britain, France, and so forth—even if the United States had zero oil imports, in the event of a world oil shortage, we would still feel the vulnerability because of the agreements we have with our trading partners. It is not inconceivable in the case where we had zero oil imports and these ties with our trading partners that the United States might be faced with the role of being an oil exporter.

What we are trying to do here is change the focus just a little from a headlong goal to reduce oil imports to zero to get to the base problem that oil imports cause, which is the vulnerability the United Sates feels to oil disruptions worldwide.

Senator PERCY. I wonder if you could both comment on whether or not, in your judgment, we have set a challenging enough goal that is still realistic. The national energy policy plan projects net oil imports to be at the 6-to-7-million-barrels-per-day level in 1985 and 4 to 5 million barrels per day in 1990. Our oil imports would seem to be approaching these levels now. The trend is extraordinarily good. Are we going to level off? Could you comment on whether or not we shouldn't aim for more challenging and more effective goals than those? First Secretary Tribble and then Mr. Chiles.

Mr. TRIBBLE. Senator, I think these projections were more of a midrange estimate. Certainly we would all hope that we would do better than this. We should expend every effort to do that. I personally would not be satisfied until we had lowered the importation of oil that we must import to zero. I think that we will see the day when we will have a choice of whether or not we import. That is the objective that I think we should all work to.

Senator PERCY. Mr. Chiles?

Mr. **Chiles.** I think the other thing we have to remember, Senator, is that one must always ask that question of, "relative to what?" I think here the question is what would the imports have been if we had not had the success we have had with the conservation and so forth. I think the levels might even be higher than the midrange projections, which is the one you chose to take.

I think Mr. Tribble made an important point here, that we did specify a range. Somewhere within that range we think the truth really lies.

It is also important to remember that many of the things we see as substituting for oil imports are long-time investments. They will take some time to work themselves into the economy. So I think the changes that we are going to see between now and 1985 are not going to be quite as distinct as the change we see between now and 1990. That is why these things are sort of phasing themselves in.

Senator **Percy.** Mr. Tribble, in the recently released national energy policy plan DOE projects a significant increase in our electric generating capacity. While certainly I am in favor of completing work on powerplants now under construction, I have heard many critics say we are rushing too fast to promote increased electricity production without giving energy conservation a good chance. In fact, you say the private sector is doing a lot. I can't go home at night without listening to P.G. & E. saying do your dishes after 8 p.m. at night and turn the washer on before 8 a.m. in the morning and prevent the building of highly costly facilities. If someone could prove to me it is more cost effective to increase electrical plant generating capacity than to invest in cogeneration or conservation-oriented technology, I would gladly support the construction of new powerplants. But I am not convinced that is the case.

Are you persuaded that we do not need to explore conservation measures and energy-efficient technologies before we go forward with other production-oriented plans? Do you think we have done really all we can in this area?

Mr. **Tribble.** No; I don't think we have done all we can in this area. But I do feel that we should go forward together with the development of new, additional sources as well as the conservation measures that we are working on and that we do know how to take.

I mentioned in my opening statement that many of the industries at the present time are not employing cogeneration. This to me is one of the opportunities that we have. We need to convince the industries of the economies of generating electric power and process heat at the same time. This process is some 25 percent more efficient than the individual generation of these two needed heat forms. The capital investment is higher, but the return is very good.

In this area, I should certainly hope that we can convince industries, particularly as they add to plant and equipment, to put in cogeneration facilities.

Another area that we should encourage is the utilization of district heating, where it does apply, and there are many places throughout the country where this will apply. It is an efficient means of utilizing the heat that is many times lost in the process of generating electricity.

On the other hand, I think one of the points that was addressed in

NEP-III was that the increased utilization of electricity can be from coal and nuclear, and thereby replace oil. Also, by virtue of the fact that it is inexpensive, it will then become more competitive with oil. So that I do feel that both of these measures should go forward together.

Senator **Percy**. With respect to the preparation of the national energy policy plan, I believe I am correct, Secretary Tribble, that you were not on the job and could not have participated in that. Could you tell me, or Mr. Chiles, whether someone in DOE's Office of Conservation and Renewable Energy did have an active role in preparing the plan; and, if so, who was that person or persons?

Mr. **Tribble**. No. No one in this Department of Conservation and Renewables did participate in that, insofar as I am aware.

Senator **Percy**. Mr. Chiles, could you tell us why, when there is a section in the report on conservation, although it is not up as high in priority or even location as I would have liked to have seen it, how it is that someone from your office did not participate in the plan?

Mr. **Chiles**. I am afraid I am going to have to have to disagree with my friend, Mr. Tribble. Unfortunately, I suffer from the same problem that Mr. Tribble does. I have only been on board since June 1, so I can only tell you what people told me when I asked them specifically that question.

As I understand the process, prior to my coming on board, the National Energy Policy Plan was circulated within the Department many months ago, between say the January–March period, and predecessors to Mr. Tribble and others did see the report, did contribute to it at that time, and that report then became the rough draft which my immediate predecessor and I took around to have the proper people looking at it. So there was a point early on where every office of the Department of Energy had a chance to contribute to that report.

After that contribution was finished, then the business, as I am sure you are familiar with, Senator, of selling what we wanted throughout the administration began. At that point, there just simply would have been too many voices if we had kept everyone involved from that point forward. But I can assure you, from what people told me in the beginning, all offices were involved in the beginning structure of that report.

Senator **Percy**. Thank you very much. Just two more quick questions in this round.

Many people have indicated and we will have testimony today stating that conservation might be accelerated if we accelerate the natural gas decontrol program. I understand that there has been a draft policy paper circulated within DOE on the effects of accelerated natural gas decontrol. I have not seen that report yet.

Secretary Tribble, did your own office participate in preparing and drafting that DOE policy paper, and will your office be involved in any additional efforts within DOE to review the effects of natural gas decontrol and develop an administration position on this policy question?

Mr. **Tribble**. Senator, here again I will simply have to answer to the best of my knowledge. To the best of my knowledge, we have not participated. I have not participated in the formation of that plan.

Natural gas, of course, is not particularly in my area of responsibility of conservation and renewables. I would not normally be involved in this, except in a peripheral way.

Senator **Percy**. Mr. Chiles, you obviously, or your office, would have responsibility for that report; would you not?

Mr. **Chiles**. Yes, sir, we did.

Senator **Percy**. Is there such a report that does exist now that tells the effects of accelerated decontrol?

Mr. **Chiles**. There are draft analyses that we have done for a mid-level working group that have been submitted to the Cabinet counsel to give them background on the issue. We do not have a formal report as of yet that we are in a position to release to the public, but obviously that is something we are going to do.

This is a very sensitive issue, as you can imagine, Senator. For this reason, we have kept it kind of close to the vest on purpose. This is why Mr. Tribble's office, for example, was not invloved and people from my office were involved. And virtually no one else at the Department of Energy, with the exception of the Secretary's Office and my office, are involved in this discussion.

Senator **Percy**. Fine. I would like very much, if I could, to study that report, on a classified basis if it is not being released.

Earlier this morning I attended some sunrise services with a very large group of senior citizens from the State of Illinois who were here for a conference. It was a heated session when discussion turned to the decontrol of natural gas. There is a very strong feeling. Sixty percent of our homes are heated by gas. Obviously, we cannot decontrol the price of natural gas without taking into account the extraordinary, unbearable cost that would be imposed upon low level or poverty level senior citizens. Senior citizens cannot turn their thermostats down in the winter. Because they are on medicaid and medicare, the Federal Government would pay the cost if these Senior citizens developed pneumonia or something like that. They are just unable to bear the lower temperatures, and we will have to bear this in mind when studying the impact of natural gas decontrol. I would like very much to study the program analysis that you mentioned.

A final question then, Mr. Tribble, knowing that we all share—and my colleagues here have been in the forefront of conservation and renewable energy and so forth—we all share a goal of improving the efficiency of our energy usage through conservation. Do you look upon your job as an activist, as an advocate for conservation? You have come into it because you believe in it. You have a track record that is enviable. Is it your purpose to stand up with us, and we will stand with you, in fighting to support conservation as cost effective? It is the lowest cost method of creating new energy. In fact, it is the biggest single new energy source available, and no ecologist will argue against this. No environmental studies will stand in the way of it. No court suits will be brought against it, as so many times we have in coal gasification and so forth. Will you look upon your position as being a strong advocate within the administration, knowing that you have a lot of strong backup, particularly with 170 Members of Congress as members of the Alliance to Save Energy?

Mr. **Tribble**. Senator, I promise you I will. That is the main reason I have for being in Washington.

Senator **Percy**. Thank you very much, indeed.

Senator Glenn?

Senator **Glenn**. Thank you very much, Mr. Chairman.

Senator **Percy**. I took 12 minutes or so. We will be a little loose on that.

Senator **Glenn**. Mr. Tribble, what was your involvement in the construction of the national energy plan III? Did you sign off on the final version of it?

Mr. **Tribble**. No, sir, I did not.

Senator **Glenn**. Shouldn't that have been run through your office? Why did you not have some say-so on what was put out?

Mr. **Tribble**. I understand, as was mentioned earlier, that this was circulated through the office before I came on board; and when I did come on board, the activity had progressed to a level above mine.

Senator **Glenn**. How about your predecessor, whoever was filling your shoes on an interim basis? Did they sign off on that national energy plan?

Mr. **Tribble**. Mr. Chiles mentioned just a moment ago that it had been circulated through there. I would like to yield to him on that question.

Senator **Glenn**. Fine. Mr. Chiles?

Mr. **Chiles**. Senator Glenn, the process that we used was to have that report within the Department signed off on down through the Under Secretary only and not down to the level of all the assistant secretaries. So Mr. Romantowski would be the lowest person that saw that report.

Senator **Glenn**. How many people had to actually sign off and approve the plan? I presume the Secretary signed off on it.

Mr. **Chiles**. Within DOE?

Senator **Glenn**. Yes. I will ask the question. Did the Secretary sign off on this?

Mr. **Chiles**. Yes. [Laughter.]

Senator **Glenn**. I had hoped so or we are in worse shape than I even thought. [Laughter.]

Mr. **Chiles**. The players that I dealt with in the Department of Energy on this report were Mr. Romantowski, Mr. Rusche, Mr. Davis, the Secretary, Mr. Pettis——

Senator **Glenn**. Did all of these people you are naming have to give their approval before NEP III was approved and sent out?

Mr. **Chiles**. The approval really came from the White House. Remember, this is a Presidential report.

Senator **Glenn**. Did the Secretary of Energy approve the plan?

Mr. **Chiles**. Oh, yes; definitely, sir. In fact, I think you will find that the letter which sends the report to you is signed by the Secretary.

Senator **Glenn**. What I am trying to get at is, what level in the Department had to approve this, because some of the stories we have heard are that people at quite high levels within the DOE were as much surprised at some of the things in this plan as we were.

Mr. **Chiles**. The approval process took place within the Office of the Secretary. This would include the people I have named already—the Secretary, Mr. Davis, Mr. Rusche, Mr. Pettis, Mr. Romantowski.

Senator GLENN. Was there any process by which those people had to actually sign off on their approval of the plan and register their objections, or was there just a general type circulation of this plan? Did they actually have to sign off and give their objections as to what they saw as serious defects?

Mr. CHILES. No one took pencil to paper and put their initials on a document. We had hours and hours and hours of wrangling discussions over this until we got a document that everyone that I named was satisfied with.

Senator GLENN. You mentioned that direction came from the White House. Did the White House tell you what to put in the NEP?

Mr. CHILES. I don't think that is the way I would characterize it. We went up there with——

Senator GLENN. How did you characterize it then? What kind of direction did you receive from the White House?

Mr. CHILES. We received a lot of direction on choices of words, how we would say certain things, that the administration, as a policy, did not want to have in the report.

Senator GLENN. Can you give me any examples of what choices of words?

Mr. CHILES. Oh, yes. One that stands out in my mind right away is, when we were talking about issue of vulnerability to oil imports and whether or not zero oil imports was a proper and only goal, we had used language to the effect that we had responsibilities to our allies. They said, no, you can't use the word allies because that is an implication of a military agreement. We would like you to change that from allies to partners. This is obviously beyond my control. I don't understand it.

Senator GLENN. Beyond mine, too. [Laughter.]

Mr. CHILES. To some people, this made a lot of difference. If it did, fine; I have no problem with that.

Senator GLENN. I can understand the military connotations difference. I don't mean to make fun of it. There is a difference between referring to people as allies, which is normally taken in a military sense, and our responsibilities under IEA that would be of a different connotation. I can appreciate that.

I won't pursue this with you for all of my time here this morning, but I just was very concerned about some of the reports we have heard from people in the Department that the first time they saw or heard much about the National Energy Policy plan was when it was announced; the fact that there was direction from the White House that this is just the way it is going to be, period; and that there wasn't much consideration given to objections from within the department. Would you think that fairly well describes the situation?

Mr. CHILES. I am never tempted to use someone else's words as my own.

Senator GLENN. Put it in your own words.

Mr. CHILES. OK. In my own words, the Department took the first crack at what this report would be early on in the January through March time frame. As things evolved over time and we started to learn more about other people's problems with policies and so forth that we were set up with, we negotiated a position that everyone was happy with whom we negotiated and we were happy with ourselves.

Senator **Glenn**. Was most of this report directed from the White House as opposed to being originated in the Department?

Mr. **Chiles**. No, sir; definitely the other way around.

Senator **Glenn**. Mr. Tribble, I have before me a list of the major achievements of the industrial energy conservation program. This was put out by DOE. It is a very good three-sheet listing. It lists all the Btu's saved under each one of these projects. The achievements are in the areas of coil coating, textile foam finishing, cross residue grain dryers, granulated fertilizer production, efficient slot forge furnace, plastic waste to fuel oil, high temperature recuperators, cogeneration, and others. In each case the potential savings are on the order of magnitude of millions of barrels equivalent per year, a very major savings. In light of that, can you tell me why the Reagan administration recommended elimination of this program?

Mr. **Tribble**. I believe merely because most of the conservation that has taken place within industry has been by virtue of the conception that energy prices were going to rise. Industry, as you know, has the real incentive to reduce manufacturing cost or cost of operation. The Reagan administration feels that industry is in the best position to judge which conservation measures would be most effective under the various circumstances that exist. Certainly those things that you mentioned in that list have had an impact. However, the major impact in the reduction of energy use or, on the other hand, the improvement of energy utilization efficiency that I mentioned earlier has been because of price.

Senator **Glenn**. I would agree, but I think the Government performs a very valuable function here as a catalyst to get people to do these things. It does some of the very basic research and then puts the information out. That program is being cut, being chopped. It comes out of the Department of Energy, as it says at the end of this thing. The last paragraph says, after listing all of these same things I named, "Other Achievements. These descriptions of technological advancements are just some of the accomplishments credited to the Office of Industrial Program." Then the last sentence says, "Substantial energy savings also have been achieved through the implementation of six energy analyses and diagnostic centers, workshops, seminars, and literature distribution to industry."

That to me is a very valuable and important function. Now, we do some R. & D. We try and make it available then, let people know about it. Then the private sector takes over.

I am not trying to force these things. I am not trying to say that Government provides all of the gidgets and gadgets that make all of these different nice things possible here that save all of this energy. And we are cutting out that program that makes this information available. We are cutting it out. We are just going to let it dribble around through publications and whatever instead of taking an active Government role in trying to reduce our oil imports from abroad.

I just can't understand why we eliminate things like that that cost comparatively little but when known by industry and put into effect do have a tremendous impact.

What would be your plans if Congress restored that funding? What would you recommend to the President?

Mr. **Tribble.** Senator, I would just simply say that if it is restored, we would spend it the best way we know how.

Senator **Glenn.** What would your recommendation be to the President? Would you recommend he veto our funding this program?

Mr. **Tribble.** In the case of R. & D., we are going ahead with a substantial amount of R. & D. in many fields, and many of those will be beneficial, of course, not only to industry but to the building industry also. We would expect that as we bring these projects to the point where they are cost effective or where they may be perceived by industry to be cost effective, that they will pick it up at that point and move it forward.

Senator **Glenn.** I couldn't agree with you more. But I think we are not doing that. I think we are cutting back beyond that point. I don't think we are doing the original R. & D. to even bring it up to the point where industry will take over. That is what I strongly object to.

I will be happy to work with you to try and get any money for any R. & D. that you think is feasible. I make a standing offer to you right now. It just really hurts me that after we have worked hard to get some of this R. & D. going, we now see it being just chopped and hacked. I just think that is tragic.

Mr. **Tribble.** Senator, a lot of those cuts are taking place in the areas of demonstration and commercialization. We are backing away from those two facets of it and concentrating more in genuine research and development. I think that is part of the problem that we see.

Senator **Glenn.** There may be some demonstration and commercialization projects that should be cut back. However, I think in some areas where there is a technology that is completely new and where people are very hesitatnt about getting into it, a demonstration project here and there is good. Coal gasification is one I have been a little sensitive to because I worked very hard on one project in southeastern Ohio and we had it chopped out from under us. It would have used Ohio's high sulfur coal in coal gasification. Conoco was going to be involved in it but has pulled back from it now and said they won't go in in any case because Federal participation has been held up so long.

When a brandnew type technology is being developed, I think the Government should support a demonstration plant or two. But I don't want to see us get into competition with private industry. However, I wouldn't agree with your statement that the Government should not fund any demonstration plants or demonstration projects.

The 1983 budget process is starting up about now. In the Department of Energy, what will be the decisionmaking process for the energy conservation budget? Do you have that under consideration now?

Mr. **Tribble.** Very much so, Senator. We are expecting to generate this budget in a little bit different form than it has been in the past. We are first setting the objectives and then we are working down from the objectives to those programs that we feel will have an important part in reaching those objectives. Then we are trying to make an estimate of the money that will be required for that. We intend to structure the budget in this fashion.

Senator GLENN. Do you plan any independent outside review of the budget before it is submitted?

Mr. TRIBBLE. Not that I am aware of.

Here again this may be just one of those problems with me being the new guy on the block.

Senator GLENN. I have just a couple more questions, Mr. Chairman.

I found nothing in the NEP which suggests that anything other than the market mechanism should be used to determine U.S. energy supply strategy. The report says, "A low level of U.S. oil imports at any cost is not a proper criterion for the Nation's security and economic health. Even at its current high price, imported oil is substantially less expensive in terms of circumstances than available alternatives."

I agree with you that a low level of U.S. oil imports at any cost is not a proper criterion, but wouldn't you agree that in the interest of national security subsidies for certain energy supplies, including conservation, do make sense up to a point if in issuing those subsidies we decrease the amount of oil imports? In other words, that we pay a premium in some respects to get less vulnerability?

Mr. TRIBBLE. Certainly that is a factor. I believe I will yield to Mr. Chiles in answering that. He may be more familiar with it.

Mr. CHILES. This is a difficult question because of trying to figure out how much such a premium is worth. There have been various discussions as low as 50 cents as a negative number and to a positive number as high as $10. I cannot tell you what that number is. I know the theory behind why people are asking for it.

But I think it is also fair to point out that if we subsidize energy sources to some level where they compete with oil imports and we roll in all energy costs, in effect we are saying to OPEC, because we have reduced this part of the energy bill, there is freedom for you to increase your price. I think people are forgetting that.

It is a difficult concept, of course. But in the economic rationale, the way I see OPEC setting its price is by looking at all available alternatives to oil and seeing what prices those command in setting their price for oil appropriately. Sometimes this is high—sometimes this is low.

If I may switch to an example in another industry: In the Wall Street Journal yesterday, there was an article about synthetic cheese taking over the market from the real cheese. This is a typical example where the free market works. The price of cheese has gotten so high the synthetic cheese is more economical. People are flocking toward it. People who make cheese aren't very happy about it.

Senator GLENN. I will have more questions later. Thank you, Mr. Chairman.

Senator PERCY. Thank you very much.

Senator Durenberger?

Senator DURENBERGER. Thank you very much, Mr. Chairman.

Mr. Tribble, from what I have been able to learn of your background and your commitment and what I have heard this morning, I, too, am happy that you are where you are.

If I may start my questions with Mr. Chiles at the point where Senator Glenn left off, it is important you concluded your statement, Mr. Secretary, by saying that the essential part of a conservation policy has got to be a realistic energy pricing policy.

You did indicate, Mr. Secretary, in response to another one of his questions, that concerning incentives for industrial conservation, industry has been anticipating energy price rises and therefore has, in effect, accomplished a certain amount of conservation and economizing in anticipation of those price rises. It seems to me that the crucial issue here, in response to this whole line of questioning, and in response to how we develop a national energy policy plan, has to be the issue of the energy marketplace.

A couple months ago, we sat in another room in the same subcommittee talking to the Secretary of Energy about this. I was totally dissatisfied with his analysis of the energy marketplace. I would rather not be unhappy with the grasp that policy leadership in this country has with the realities of the marketplace. Let me start by asking, Mr. Chiles, if we decontrolled the price of natural gas completely, would it rise to a price equivalent to that of oil on a Btu basis, or maybe even a little bit higher because of its premium quality?

Mr. **Chiles**. No. 1, Senator, it depends on where you are talking about the price. If you are talking at the wellhead, I think not. I think natural gas, if it were in theory decontrolled totally, would rise to whatever price would allow it to compete with its competition in the marketplace, no matter what that competition is, whether it be wood, coal, oil—you name it. When people, though, take that through to conclusion, they assume that probably the closest fuel at the moment that is its competition would be No. 2 fuel oil in the home. But there is no reason why they couldn't also make that kind of comparison with, say, electricity. There it also competes.

Senator **Durenberger**. Using your cheese example—which I am probably more familiar with than I am with some of your other examples [laughter] is there any doubt in your mind that the equivalent of natural cheese, in your example today, is crude oil or No. 2 diesel?

Mr. **Chiles**. It seems to be, but I am not sure whether that is a factor or coincidence. For example, if you look at residential heating over the last 5 or 6 years, you find 60 percent of the new housing starts would have electric heat. You might in theory therefore say we should look at how it competes with electricity. I don't think that is quite correct. But depending on what statistics you choose to pick, you could make that case as well.

Senator **Durenberger**. Why don't you describe for me your theory of the marketplace out there. Then we can go on from there.

Mr. **Chiles**. OK. On natural gas, I think if you take the position that decontrol should happen, and it does, I think you will find a marketplace seeking a price for natural gas. I think, in the short term, much like when we decontrolled oil, you will see natural gas prices kind of overshoot. At that point then, the markets won't clear. People will not buy gas at that expensive a level, and the gas companies will have to reduce their prices. Eventually you get an equilibrium where relative to its competition, the American people think the price they are paying for natural gas is fair relative to their other choices for the particular end-uses they have in mind. Whether that be comparing against oil, wood, coal, electricity, is up to that individual. But the aggregate decisions are going to put all of those fuels at their relative prices with each other according to who wants to buy what and what it is worth to them.

Senator **Durenberger**. Now give me your description of the marketplace that sets the price for oil.

Mr. **Chiles**. I am not sure it is. It may be. But I am not sure whether that is a factor or a happenstance.

Mr. **Tribble**. Senator, could I address the question on natural gas, if I may?

I have been burning natural gas for 30 years and have some knowledge of what goes into the price. I feel that if natural gas is decontrolled, it will depend on the use that it is competing with. Actually, you will find that in the southern States, in the wintertime, the capacity of the gaslines are used almost fully in supplying firm gas, which is for large residential use, and small commercial use, and things of that nature. But then as the weather warms, that demand reduces and then the gaslines need to have a customer who can take what they term interruptible or dump gas, so that they can keep the flow in the pipeline high enough to amortize the pipeline cost.

So it has been my experience that in the wintertime, when the capacity of the pipeline is fully used, then the price of natural gas could quite likely rise to compete with middle distillates.

But on the other hand, when that demand is not there, the price of gas will fall and compete with whatever the alternative is, be it either residual oil. They have not been able to, so far as I know, get down to compete with pulverized coal at present-day prices. But those are two influences that I feel will have a strong say in what the price of natural gas will be.

Senator **Durenberger**. Let me get back to who sets the price for oil—real time; forget about happenstance. Who is setting the price for oil today, and in the near future?

Mr. **Chiles**. I think the price of oil is set in the long term on the marginal cost of all of the alternatives to it. It is an aggregate package of what the cost is of electricity from coal, coal direct, natural gas, hydroelectric power, conservation, renewables, that whole package of goods.

I think what you are implying is possibly Saudi Arabia is in charge of oil pricing in the world. I think we have to remember that the United States did a tremendous job of giving the Saudi Arabians all of that good education in economics at Harvard. I think they learned this lesson well. I think if you look at the history of the price of oil worldwide, you can make quite a case that it is priced at the marginal cost of synthetic fuels. So whether to say the Arabs are setting the price of oil or whether the price of synthetic fuels is setting the price for oil is kind of a chicken-or-egg question. I am not sure you can say which did which.

Senator **Durenberger**. I didn't go to Harvard at the time. I didn't go to Harvard at all. I don't know what they learned there. [Laughter.] But just looking at what is going on out there, it seems to me they learned something—wherever they learned it. Clearly, the market which you described is a good way to describe a market. It does not necessarily describe the way the prices are set in the United States.

Saudi Arabia right now is clearly in a great monopoly situation. They have enough oil to lose clearly into the next century—even at current production rates. It seems that they looked at the impact—this is looking back a few months—of a $40 price of oil in this country and they saw just what the Secretary saw. They say an awful lot of conservation starting to take place in this country and just said that ain't good for us. It was clearly a threat to their production interests, so they continued to flood the market with oil. They forced their partners in OPEC to back down to a $32 a barrel price. They demonstrated again that they are a monopoly power.

Am I right in looking at, and characterizing, who is in control of today's market? It is the Saudi Arabians; is it not?

Mr. **Chiles**. Is it? Or is it we, who are able to have the amount of conservation that forced them to make the decision that they didn't want to make necessarily?

Senator **Durenberger**. Who is setting the $32 price for oil today?

Mr. **Chiles**. I think the price of $32 oil is set by the fact we have substitutes for it, which not to any small extent includes conservation, which says you don't need it at that price.

Senator **Durenberger**. If they can decrease the price from $40 to $32, they can also increase it. Or, is it your judgment that we are in a position now to increase or decrease it?

Mr. **Chiles**. They could increase it, but if our response is more conservation, more synthetic fuels, more hydroelectric power and nuclear- and coal-powered generation, we can thwart their efforts again, just as we did this time. In the short-term, from 1973 on, they might have been in the driver's seat, but we are starting to get control of a few levers ourselves.

Senator **Durenberger**. I am trying to get back into the conservation notion here, and trying to figure out how conservation is going to fare in this whole marketplace.

Wouldn't it be fair to assume that subsidies for conservation are going to bring the price down in this marketplace?

Mr. **Chiles**. I have seen facts that some of my people have shown me, for example, that weatherization costs equivalent of $26 a barrel of oil equivalent. Now I ask myself if the price of oil is $40, $32, whatever price you want to use, why would you therefore subsidize something that already costs $26?

I think what we have to do is get a little bit of a historical perspective here. Back in about, say, the 1978 period when we had a lot of these kinds of subsidies starting, they were very much needed. The price of oil at that time was projected in the year 2000 to be some $20 a barrel. Today it is already $40.

Now what we are seeing is that those subsidies were needed then to get over, if you will, a hurdle, to get these technologies into the marketplace where they could compete on their own.

I would submit to you, sir, that not only are we over the hurdle but the hurdle has been cut in half as well. I don't see subsidies are needed to get the same effect. I think what we ought to be doing is taking those subsidies and putting them somewhere else where they are needed.

As an example, some of my folks have done a lot of study on vulnerability and how one reduces it. We find we get a much bigger bang for the buck if we take funds that would theoretically go for conservation and instead build a petroleum reserve. That—if vulnerability is your chief issue—is a better way to spend those dollars.

It is that kind of complicated issue we are dealing with here. Taking the pieces in isolation really doesn't give us the full picture.

Senator **Durenberger**. We need something in our policy. You bring up the SPR. What I am searching for is the consistency in current administration policy so that I can feel confident that a nation which appears to me to be as unstable as the nation we are talking about is not in some way determining the world price for crude oil.

I would agree with you, that in looking at financing, the SPR is an important alternative. Yet, some of us tried to do that on the floor 6 or 8 weeks ago and didn't get an awful lot of support from this administration. I know it was in the recommendation to fund it, but it really came down to using the same kind of muscle we see the administration using in other areas, it just wasn't there. Now we don't see much of it in the conservation area. When you look at the various determinants, and you look to find an appropriate governmental role, I don't believe that we should be directing this whole thing. Finding the appropriate role for Government within this administration's policy is very, very difficult to do. I am led to the conclusion that the administration has a different version of the marketplace than I do, and that they don't really believe the Saudis can affect the price of energy through the price of oil in this country.

Mr. **Chiles**. Let me try to state for you in my own words what I think the administration position is on where you subsidize and where you do not.

As I look at it, from the discussions I have had in the time I have been here, I am pretty well convinced that where the administration is coming from is this: If a particular energy source, whether it be renewable, coal, nuclear, conservation, what have you, is able to compete on its own, then subsidies are no longer needed and should be phased out as quickly as possible. Where you have an energy source or some other way of taking care of an energy problem that is not quite competitive today, but stands as a good chance of being competitive in the near-term future, the Government should fund getting that over its hurdle. Where energy sources or other means are so far in the future that it is very clear that private enterprise will not get a return on its investment, such that it will attract their capital, clearly the Federal Government has to have the major role there. Fusion would be an example of that kind of thing. That is how I see it breaking down.

I guess what we are arguing back and forth is, where does conservation fit in here? I am saying that programs such as weatherization and things of that nature tend to fit in category 1, which says they can compete on their own in the marketplace right now—and is a subsidy logical? Things like photovoltaics, for example; I would say research and development on photovoltaics themselves are in category 2, just about to the point where they can compete in the marketplace but not enough that they will on their own, so let's subsidize them a little longer because in the long-term, it looks like they have the potential to be competitive.

If I may go back to my 21 years with a major manufacturer, my company was working toward getting photovoltaics down to 70 cents a peak watt and for Government subsidies to make sure we reached that goal in 1987.

Senator **Durenberger**. As I understand part of your statement, you do believe there are some near-term technologies that are appropirate for us to consider financing?

Mr. **Chiles**. Yes. There are two criteria that need to be met. You need to have some assurance in the relatively short term they will become economic on their own. No. 2, the profits have to be far enough away that the technology cannot attract private capital.

Senator **Durenberger**. I am happy to hear you say that. It is not quite the way NEP–III reads. I just happen to agree with that particular thesis. I understand that I have used up my time.

Mr. **Chiles**. I contradicted myself.

Senator **Durenberger**. You are being sensible. [Laughter.]

Senator **Percy**. There is a feeling that regulation is something we just ought to do away with. This subcommittee has the responsibility for overall Government regulation. We have introduced a bill on regulatory reform. We are all for it. But we still reaffirm the fact that we are not going to sweep away the National Deposit Insurance Corporation or SEC or the Nuclear Regulatory Commission.

I wondered if you could either now, or for the record, give us examples of regulations in connection with conservation that still make sense. Even though we think that market pricing, the natural free market, will be the best regulator in the end, we still are not going to do away with the 55-mile-per-hour speed limit. I worked on that for a couple of years, introduced the legislation. It is now law, I will fight against any attempt to overturn it. It saved 40,000 lives, millions of barrels of oil. It is sensible.

Now that is sensible regulation. We wouldn't do it normally, ordinarily, ourselves. There has to be a certain amount of regulation in life. For instance, look at this building. We fought for years to have sensible conservation standards established. I would come in here year after year and in the middle of summer, I would see people with sweaters on. We liked to turn the temperature down and feel that when you walk in the building, it is going to be cold. So you put sweaters on in the summertime. You want to come in in the wintertime and work in shirt sleeves. That is the way we have been raised. They don't do it in England or any other country on Earth. It was just crazy. We finally had to move in the direction that put impetus behind the building superintendent and had to demand, the majority and minority leaders, that he obey the regulations that have been laid out and conserve energy in this building and set an example. We finally got around to it.

What other examples are there with regulation, uniform standards, that are a good thing and not a bad thing, and that prove that we are not going to do away with all of the sensible guidelines and standards? Either give that to us now, Secretary Tribble, or for the record, so that we can see the trend of thinking in the Department, that we are not just going to deregulate everything overnight and say in a perfect society we will all do exactly what is in the national interest. We just don't do it.

Mr. TRIBBLE. We certainly will give that some thought, Senator.

[The information referred to follows:]

Despite considerable thought, we have been unable to think of energy conservation regulations which clearly fit these criteria. One which may nearly do so would be a regulation which requires a new building to be designed to meet a certain energy efficiency level in order to qualify for Federal Government financial support.

Senator PERCY. Thank you very much.

One of the major objections to the market approach in energy conservation is that low-income households are often unable to raise enough capital to invest in energy-efficient improvements. It is not yet certain whether the community development block grant approach will adequately adjust the needs of all low-income households desiring to make such improvements.

What plans does DOE have, and your office in particular, to address the problems of these lower-income households?

Mr. TRIBBLE. Senator, we certainly do share your concern on this problem. We must not, as a Nation, permit those people who can't afford to buy fuel to be cold. It is my understanding of the policy in the Department of Energy that this does not properly fall within our purview but would be better handled in those Departments of the Federal Government that are more familiar with this kind of a problem. So we have proposed that this activity be given to those departments.

Senator PERCY. Can it be, though, that your Department should take the responsibility for the coordination? No one else is going to do it on their own. That is your mission in life. If, for instance, we are subsidizing and supplementing the incomes of low-income families to pay heating bills, but for a modest investment they would be able to weatherize their homes. We would get a return on investment paid off in 2 years, 3 years sometimes. Yet we will continue for the next 20 years to subsidize those energy costs, supplementing their income to pay those energy bills. Isn't it much better, then, for us to take the initiative? Can your Department assume some degree of responsibility, if it is in Health and Human Services, or wherever? Can you be the catalyst to see that that is done? So long as it is being done someplace else, that is fine. But no one is going to take the initiative, as I see it, unless it is done by your Department.

Mr. TRIBBLE. Yes; we can certainly do that. In addition, we are studying the things that we can do that would be most cost effective, the items of conservation that can be done, that will give the most comfort at the least cost and have the longest effect.

Senator PERCY. Fine. In your response to our prehearing questions—I appreciate the quality of the answers that were provided to this subcommittee—about the lack of incentives for conservation in rental housing, you warned that, "More should not be made of this problem than is warranted." We have a great deal of rental housing in Chicago and other Illinois cities, and neither landlords nor tenants have much

7

to gain, as things stand now, by investing in insulation or other conservation improvements. I think it is unfortunate, especially in the case of low-income tenants who face ever-rising energy bills. In your response you concluded that "Private institutions should basically be left alone to deal with this problem." Could you further expand on this? What did you mean by it and what are your reasons for feeling this way?

Mr. **Tribble.** In many leases that have been effective in the past when energy was not a consideration, of course the utilities were included as a part of the rent. As those leases have expired and been replaced, in many instances the utility cost has been separated out of the leases and is an additional burden on the renter. This, of course, brings it to that person's attention a great deal more forcibly.

Also, the new buildings that are being built are a great deal more energy efficient. In many instances they have separate meters for utilities, so that the tenants do in fact get their own utility bills.

These are two ways in which this can be addressed. Admittedly, this is a difficult problem because, as you have stated, in many instances the landlord doesn't have the adequate interest and the tenant doesn't have the adequate interest. However, if we look at this over time, we will see that the energy efficiency of a rental unit is becoming an important sale point by those who have apartments and houses to rent. So that we feel that the market is working, although perhaps more slowly than we would like.

Senator **Percy.** Following in the next panel will be Linda Gallagher, executive director of the Alliance to Save Energy. As I have pointed out to you, probably no agency of Government has a stronger private sector advocate to help you with your work than we have in the Alliance. Virtually every member of this subcommittee is a member of the Alliance and has been very active in its work.

There is a contradiction, however, in the testimony that Ms. Gallagher will be giving in that the Alliance has taken the position that oil production in particular is favored over conservation. The Alliance maintains this even though a third of the Alliance budget is provided by oil companies, who spend their money to tell the public to use less of their product, and to use it much more effectively and efficiently, which I think is the height of public service for any industry.

In your response to one of our prehearing questions you did make the opposite statement. I will quote what you said. "Energy conservation is given special tax incentives while oil production is subject to special taxation." I will give both of you a chance to comment on this.

In general, do you think conservation fares as well as new energy production in our tax policies?

Mr. **Tribble.** Senator, in answer to that question, we were thinking in terms of the fact that there is an investment tax credit for conservation and there is also an additional credit for "energy property." Those were the subsidies that we had in mind.

The other side of that was that there is the windfall profits tax that is applied to oil. Now I have not seen a projection or calculation that does in fact take into consideration all of the tax aspects, so that you could have a proper comparison between the way conservation is treated as it compares with the production of oil. I think that would be a very interesting comparison to see. It should take into consideration the facts that the use of oil, of course, is an expense for industries operating at cost. These kinds of things I believe should be examined. I am sorry; I don't have that information at this time.

Senator PERCY. Thank you very much. Because I have a meeting with the majority leader coming up fairly soon, I would like to hear the next panel, so I will put the rest of my questions in the record and ask that they be answered. We want to give Senator Levin also a chance to ask questions.

Senator Levin, you have not had a first round, have you?

Senator LEVIN. No.

Senator PERCY. Does your time permit that, Senator Glenn?

Senator GLENN. Fine.

OPENING STATEMENT OF SENATOR LEVIN

Senator LEVIN. Thank you, Mr. Chairman. I thank you, Senator Glenn.

I am also having trouble discerning the conservation policy of this administration. You have zeroed a number of programs in the budget that promote conservation. The residential conservation service was zeroed; technology and consumer products program, zeroed; industrial conservation program, zeroed; solar energy and energy conservation bank, zeroed. We put back some money for the bank, but the administration's budget came in with a zero figure.

One of the first things that the President did when he came into office was to terminate the emergency building temperature restrictions, restrictions that have been estimated by the Department of Energy as possibly saving somewhere between 200,000 and 400,000 barrels of oil a day. Frankly, I have not seen a conservation policy that has any teeth. There is a lot of concern which is expressed. I think there is a heavy emphasis on concern and pretty light emphasis on commitment.

I have been disappointed, frankly, in the administration's lack of a clear-cut conservation policy. But to help us discern the outlines a little better, I am wondering if you could give us some definitions.

I have heard some definitions this morning about short term, medium term, midterm. Can you tell us what your definitions are for category 1, category 2, and category 3, and beyond?

I guess category 1 is an energy source which is competitive now. Category 2 is something about midterm or near-term. Can you just define what those categories are for us?

Mr. TRIBBLE. Senator, I don't have any specific number of years that I could apply to these. Let me simply express my own opinion here.

I think that near-term is something that the industries and others can take over almost immediately, 1 year or so. I would, in my own opinion, feel that mid term would be beyond 1985 and that far-term might be beyond 1995. But I must say that these have no official connotation—that they are merely my thoughts.

Senator LEVIN. We appreciate that. I think, Mr. Chiles, you used category 1, category 2. Can you tell us what those goals are?

Mr. **Chiles**. Senator, if I said that, I don't remember in what context. It may have been when I was answering Senator Durenberger's question about where should the Government invest and where they shouldn't.

Let me put it to you this way: I think things that are economic on their own today, are demonstrable projects, do not need a subsidy any more.

Senator **Levin**. Is that category 1?

Mr. **Chiles**. Let's call it that.

Senator **Levin**. I am just trying to find out what you are calling it.

Mr. **Chiles**. I don't remember using the words. If you would like, we will call that category 1. Category 2, if you would like that, we will call things that are not yet economic and do not show a return on investment such that private enterprise is willing to put money into it at the moment, but yet, a few years down the road, and let's make it maybe 5 or so, would show a profit and be something that could compete on its own. Let's call that category 2. That would be something I would see, and I would call it in the R. & D. range, something that is not ready to go to market now on its own. Then, to continue into category 3, I would call the category 3 things where there is no way to know yet whether the thing will compete in the market, ever, but it looks like the changes are pretty good and the cash flows are far enough away that there is no way that private industry could afford to put any money, or maybe just a little, into it because they could never see a return on that investment.

If you want to call that 1, 2, and 3, I will call category 1, demonstration projects. Category 2 would be short term R. & D., where you can see the payoff coming. Category 3 would be long-term R. & D., where you are not sure you are ever going to see a payoff, but you think there is a good chance of it and it is a good gamble and you are willing to take that bet.

Senator **Levin**. In the National Energy Policy plan that was just released, on page 3, the following statement is made: "Its vision"—that would be the Nation's vision—"would be equally narrow if market forces were distorted through indiscriminate subsidies for alternatives that cost more than imported oil now and offer no short-term to mid-term likelihood of being economically competitive."

Why did you leave out far-term in that statement? What about alternatives that have a far-term likelihood of being economically competitive?

Mr. **Chiles**. Why would I leave that out?

Senator **Levin**. Why would that be left out of that statement?

Mr. **Chiles**. I am not sure of the context of your question. I am trying to strain into what you want me to say.

Senator **Levin**. I just want you to—I am not trying to get you to say anything. I am trying to understand what this statement is. Perhaps you can explain why it is that you left out the far-term likelihood there, as you just described it. You called it category 3. Was that consciously left out of that statement?

Mr. **Chiles**. Yes. I think it was left out on purpose. I think what we were saying was things like fusion and things like that, where you haven't even proven laboratory feasibility, you do not want to remove the subsidy until you are sure they cannot be an alternative. What we are saying is, don't subsidize things that you know darn well today are economic on their own. You can subsidize for short-term R. & D. things that you think have a chance of being economic, let's say, between now and 1990. We will even put 1 year on it. Things in the far future, where you have no way of telling whether they are economic or not but you think have some chance for viability, you ought to be funding to the extent needed to find the answer to that.

Senator LEVIN. If we could just look at that statement for another moment, if we can put it positively rather than negatively, the statement says:

> Its vision would be equally narrow if market forces were distorted through indiscriminate subsidies for alternatives that cost more than imported oil now and offer no short term to mid term likelihood of being economically competitive.

If we could put that positively, does this policy then say that it would be a broad vision for us to make wise subsidies—not indiscriminate, but wise subsidies—for alternatives that cost more than imported oil now but offer a short term to midterm likelihood of being economically competitive?

Mr. CHILES. With one caveat, I will say yes. That caveat is, are they far enough along that the private industry sees the profits in the future that they can do it themselves? If they can do it themselves, then there need not be subsidies. If not, then yes, of course.

Senator LEVIN. Then putting that positively, if they can be funded by private industry, they don't need subsidies; that you would support subsidies for alternatives that cost more than imported oil now, if they offer a short term to midterm likelihood of being economically competitive?

Mr. CHILES. Yes, we would. But we would cut that off at the point where they do become competitive. In other words, we talked about it earlier, about a hurdle to go over.

Senator LEVIN. Of course. Then looking at that positive statement, you would then support subsidies for alternatives that cost more than imported oil now if they offer short term to midterm likelihood of being economically competitive? Would you add to that positive statement if they also offered long-term likelihood of being economically competitive?

Mr. CHILES. I am not sure I see why you are asking me that. I think all along whether or not we even know whether in the long-term certain technologies are going to be economic or not, we have to support them just because it is basic research and we need that answer.

Senator LEVIN. I would think so, too. That is the reason I am pressing you on this question, which I consider to be critical and which is right in the summary in the beginning of this plan. I think if you look at it again and frame it in the positive, you will see why there is an omission in that policy which I have tried to point out here in terms of long-term likelihood of being economically competitive. I don't think you want to leave that out on that phrase.

Mr. CHILES. Let me go back and work on it.

Senator **Levin**. Finally, Mr. Chairman, as I understand your answer to Chairman Percy's question, it is that you will—and this would be addressed to you, Mr. Tribble—that you will be looking for some simple regulation that can replace the emergency building temperature restrictions which were eliminated. Did I understand your answer to Senator Percy's question correctly?

Mr. **Tribble**. My answer was not that specific. The question was would we look for regulations that would be simple, easy to enforce, and effective. I said yes; we certainly would.

Senator **Levin**. That would be in the area of the emergency building temperature restrictions?

Mr. **Tribble**. That would be in a broad area, in whatever way we might address this, not necessarily limited to building temperatures.

Senator **Percy**. I did not phrase the question specifically for that. It was a general question. You are quite right.

Senator **Levin**. I am sorry. I misunderstood the question. I am sorry for that. It would include those building temperature restrictions?

Mr. **Tribble**. Yes. It would include the consideration of such a thing.

Senator **Levin**. Thank you, Mr. Chairman.

Senator **Percy**. Thank you, Senator Levin.

Senator Glenn?

Senator **Glenn**. I would first suggest to our staff, Mr. Chairman, that in the future we check the temperature of our own room here in the interest of energy conservation. I am at about meat locker temperature myself right now. I don't know about the rest of you. [Laughter.]

I think we could heat up our room here a little and save some air-conditioning energy.

Senator **Percy**. I want to tell you a story. When we complained bitterly that the temperature was too hot in the winter, about 2 winters ago, it finally was brought down until Senator Kennedy discovered that in order to bring the temperature down, they had turned the air-conditioning on, explaining this building was quite old and it was very difficult to control the temperatures. If we wanted it colder, they were going to make it colder. [Laughter.]

Senator **Glenn**. I hope it will be better when we are in that new, more efficient, less expensive building next door. [Laughter.]

Mr. Chiles, you talked about your previous experience in industry. You felt the photovoltaics would be practical by 1987. Your company was hoping for some Government help to tide them over. I agree with you and I agree with your company in wanting some Government help. Do you then agree with the budget cut in solar photovoltaic research from $161 million to $61.9 million in the buudget?

Mr. **Chiles**. That is a toughie isn't it.

Senator **Glenn**. It is for me. [Laughter.] I don't know about you.

Mr. **Chiles**. It is hard for me, with 21 years in one career and suddenly dropping it for another, so that I don't transfer too easily.

As I understand what is going on in the photovoltaic budget, though, it is the demonstration projects that are being cut and not the R. & D. projects.

Senator **Glenn**. Technology development in the photovoltaic program was cut from $74 million to $11 million. I just happen to have the budget documents right here. There are some other areas. Systems engineering and standards cut completely. Tests and applications were cut completely. The January budget request had market development funded at only $1.5 million, and it was cut to zero. I just think these actions are absolutely mind-boggling stupid. I just can't believe we are not adequately funding promising new energy sources.

I would say that Mr. Stockman, bless his soul, sat in the same chair you are sitting in right now during his confirmation hearings, and he told us about the administration's dedication to R. & D. He probably put his red pencil to most of the R. & D. he could get his fingers on. I just can't see the wisdom of that. I think it is just crazy, with the vulnerability we have in our country, to be cutting research on things like solar photovoltaics. I just hope you can bring some sense over there to the place and get some money back in R. & D.—not out competing with private industry, but doing the research that will let us achieve some of those breakthroughs. That to me is the answer to our long-term energy problem.

Speaking of long term, how do we determine what is long term and what isn't? Who makes that decision at the Department of Energy? DOE is saying it will stick with the long-term stuff. Who makes a determination of what is long term, midterm, short term? Do you do that? Mr. Tribble, who does that?

Mr. **Tribble**. We generally do that when we look at the individual R. & D. or the individual project that we are working on. Here again I think that perhaps maybe too much emphasis has been put on that term. We are giving some consideration to things that we would hope to have some productivity from prior to the long term that I mentioned earlier.

For example, in the development of the electric vehicle, we are pushing that and pushing the development of the batteries to drive it. We would anticipate that this will bear fruit in less than the long-term context that we have discussed.

Senator **Glenn**. How long do we figure the breeder reactor is going to be as opposed to synfuels?

Mr. **Tribble**. I am sorry; I can't answer that one.

Senator **Glenn**. We are apparently going with breeder technology that is now obsolete. There must be other reasons than energy that we are going that route.

Mr. **Chiles**. As I understand the program, from what I have seen of it from both sides, it looks like we are looking at somewhere in the nineties for a Clinch River type reactor to be completed now.

When I look at the nuclear picture to see when a breeder will come in, it has a lot to do with the various economics of the total nuclear cycle. I am not sure that is an answer I can give you right now, Senator.

Senator **Glenn**. I know these things are subject to judgment. Some are longer term than others. We have to exercise some judgment on them. I can appreciate that.

We are on a vote. The chairman has gone to vote. I will have to leave in about 5 minutes to go vote myself. So let me get into another area.

Market response has a lot to do with what kind of research we support. Dr. Arthur Rosenfeld at Lawrence Berkeley Lab estimates that market response in the building sector to oil and gas deregulation may take about 20 years unless—a big unless—the Federal Government takes some limited but critically important leadership roles to accelerate that response. How important is it to accelerate this response? Well, our annual energy bill is about 1 million barrels per day. Roughly a third of that goes into energy for buildings of one kind or another--heating, air-conditioning, and so on. It is apparent every year we can advance the market response, we can save tens of billions of dollars. Yet we are cutting out those programs designed to accomplish this. Would you comment on this?

Mr. **Tribble.** Senator, in that area, most of what is being cut out, it is my understanding, is the demonstration-type thing. We are going ahead very much with—let me elaborate on this just a little bit.

We found in recent years, since energy has become a higher cost item, that some of the old parameters that we have been using for the determination of heat losses in buildings are not as accurate as we would expect them to be. As insulation is added, as the infiltration is reduced, new problems are being created, new parameters are being developed. For example, in the past it was not unusual to highly oversize a furnace and little consideration was given to the fact that when a furnace is operating at the lower end of its capacity, it is not operating in an efficient mode. We are giving considerable study to that kind of thing so that we will be able to pass to the private sector information that they can use in making smart choices of conservation measures; and when they replace that kind of equipment or when they put this in a new building, that they can do so with some good guidance. This is really important.

I certainly agree with you on the fact we need to develop means of retrofitting existing buildings. I think that perhaps is more important than the new buildings because we know what to do with the new buildings. But if we can come up with some good recommendations on cost effective means of retrofitting, then we will be in a position to save the kind of money that you were talking about just a moment ago.

Senator **Glenn.** I hope we can expand the funding in this area. I am told here that the conservation budget for buildings and community systems was cut from $99 million to $31 million—two-thirds of it cut out by the new administration. I just can't believe the direction we are going with the new administration. I just can't believe we are sitting with intelligent people over there making these decisions and hoping that somehow lightning is going to strike, and that things will all work out in the end. It is just unreasonable to me to think that is going to happen.

NEP III says that the administration recognizes that:

> Some energy laws that remain in effect are not completely consistent with the administration's guiding principles, but there are a number of instances in which the administration has determined that precipitous change would be undesirable.

Can you tell us which laws the administration is referring to?

Mr. **Chiles.** I can't tell you all of them, but I can give you a few examples. One, for example, let me take a break on my income tax for adding insulation in my house in Pittsburgh. I certainly didn't need that. That was cost effective already. Yet to take that kind of thing out, you know, there are too many other issues right now that are more important than worrying about things like that. But there are a number of those that aren't needed anymore.

Senator GLENN. For the record, could you give us a list of those laws?

Mr. CHILES. Yes.

Senator GLENN. I would appreciate that.

[The information referred to follows:]

The statement in NEPP upon which your request was based is intended to underscore the Administration's intention to rely on free market forces to determine the production and consumption of energy resources. As indicated in the Plan, our energy policy is part of the President's Program for Economic Recovery. That program is designed to create an economic climate that will allow the private sector—not the Federal government—to decide how best to produce and use energy. Federal intervention in the marketplace can be justified only when there is clear evidence of market failure. It is our judgment that such evidence is lacking in most areas of energy supply and demand.

Some energy legislation passed during the last several years, including the Natural Gas Policy Act, the Powerplant and Industrial Fuel Use Act and the Emergency Petroleum Allocation Act contains provisions that appear inconsistent with the principles outlined in NEPP. We are reviewing these laws and will make our recommendations to the Congress as our reviews are completed. We have already reviewed the provisions of the Emergency Petroleum Allocation Act and proposed that this Act not be continued. In this context, it is important to note that the National Energy Policy Plan clearly states the Administration's judgment that precipitous change is not desirable. We will work closely with the Congress to amend the specific provisions of these laws which are inconsistent with the President's Economic Recovery Program and the NEPP.

In addition to recommending certain legislative changes, we will continue to look closely at the manner in which energy laws are administered in order to fully apply the principles outlined in NEPP. The Department's budget, for example, is designed to emphasize financial assistance to promising long-term, high risk research and development that the private sector and the free market cannot reasonably be expected to undertake. In addition, DOE is participating fully in the effort headed by the Vice President to identify and eliminate unnecessary and burdensome Federal regulations. Other actions, that will allow greater decision-making flexibility by States and local governments also are in line with our goal to limit the Federal role in energy markets.

All of these efforts are designed to develop energy policies and administer energy programs that fully reflect the principles set forth in the National Energy Policy Plan.

The Office of Management and Budget has advised that there is no objection to the submission of this information to the Congress from the standpoint of the Administration's program.

Senator GLENN. I would also submit for the record a statement that I would make with regard to industrial energy conservation. I am indebted, I must admit, for much of the information here to an article by Dr. Douglas Harvey who helped put together the first conservation plan for DOE back in 1975.

[The statement referred to follows:]

INDUSTRIAL ENERGY CONSERVATION

The most energy-intensive industries, include steel, aluminum, chemicals, refining pulp and paper, food processing, glass, cement, textiles, and copper. These industries account for nearly 80 percent of the total energy consumed in the industrial sector. One of the reasons for the increasing competitiveness of European industry has been the much larger government investment in energy saving process technology development in Europe. For example, in 1980 the government of West Germany invested more than $128,000,000 in such development.

In the steel industry the average U.S. plant consumes about 30 million Btu per ton of product, of which 6 million Btu's are derived from oil and gas. By comparison, the Japanese industry averages 24 million Btu's per ton with only 3–4 million Btu's of oil or gas. Only two significant process developments have been introduced by U.S. manufacturers in the last 15 years, the continuous galvanizing of sheet-stock and the still experimental work of ARMPCO on coal injection in a blast furnace. During this period Japan has optimized plant layout, blast furnace design, and feed preparation, as well as adopting the process innovations of others. Most recently, the Japanese developed and introduced the dual-phase annealing process for sheet-stock which permits forming of stronger, lighter weight atuomotive parts and can be accomplished in 10 minutes (as opposed to 10 days by conventional batch annealing).

Without significant new innovative process developments that could potentially leap-frog foreign technology, the prospects of the U.S. steel industry are rather bleak. Such potentials as direct coal reduction of iron ore, from coke, plasma reduction, inexpensive casting techniques, advanced continuous annealers, etc., should be investigated. Such projects are expensive and involve a high probability of failure, 5–10 years are required for their development. To assume that the steel industry itself would conduct advanced technology development in their current economic condition as a response to raising energy prices or more rapid equipment write-off appears to be naive. Increased energy prices will increase production costs, decrease profit margins, and place a further squeeze on the industry. The more likely result will be further shutdown of U.S. capacity and greater dominence of the U.S. market by foreign producers which have captured nearly 20 percent of the U.S. market.

The cumulative investment by the Federal Government since the initiation of the industrial conservation program has been about $140 million. Of the 200 projects undertaken, eight have been completed and are saving today about $60 million per year of avoided energy costs to the corporations using them. These corporations pay taxes on an average of about 40 percent of gross profits, therefore, the return on the $60 million saving is about $24 million per year to the taxpayer. If the Government continues to invest in this program by 1985 it would have invested about $500 million. Assuming 40 percent of the projects fail, the successful ones would generate energy savings of 1 quad per year at a value of about $6 billion, the tax return to the Treasury would be $2.4 billion per year. This should be compared with Government expenditures for finding new supplies of energy. We currently spend $2.7 billion per year in allowing deductions for oil and gas exploration and $1.6 billion in depletion allowances. There is no return to the taxpayer on these expenditures. We are proposing to spend $1.2 billion on the Clinch River Fast Breeder Reactor program which will not be used by our electric utilities until about 1995 if it is ever used.

I therefore suggest that the administration program is inconsistent considering its own desire for efficient investment in high-risk R. & D. that will yield significant benefits while at the same time, projects that would yield near-to-medium-term benefits are being pushed down the drain. The administration's strategy for the development of new supply ignores the fact that energy supply companies have and will continue to spend a large portion of their gains in diversification. It ignores the essential importance of reducing energy demand in the end-use sectors of residential/commercial, transportation, and industrial through improved efficiency of energy use. Improvements in energy productivity will not result from price incentive alone and consequences of following such a program will be further deprivations to the consumer, irreversable loss of critical industries and an increase in the inflation rate over the next few years.

Senator GLENN. We may have additional questions to submit to you. We appreciate your appearance here this morning very much, gentlemen. We will also appreciate your response to any additional questions that might be submitted to you. It has been a very interesting morning. I wish we had time to consider and go ahead at more length here. I am sure you are just as happy the morning is over. [Laughter.] But this being your first time before the subcommittee, we look forward to seeing you again a number of times in the future. Thank you.

Mr. CHILES. Thank you, sir.

Mr. TRIBBLE. Thank you, Senator.

[Responses to prehearing questions and responses to written questions submitted by Senators Percy, Glenn, and Jackson follow:]

RESPONSES OF MR. TRIBBLE TO PREHEARING QUESTIONS

POLICY

Question 1. Although, in general, the free market is an effective means of promoting energy conservation, there are instances in which the market does not function freely due to institutional and other barriers. Where have DOE and your office identified failures in the free functioning of the energy market with regard to conservation? What methods do you plan to use to compensate for these market failures?

Answer. The main imperfection in energy markets, of course, has prices controlled by the government. To help correct this situation, the President removed controls on oil markets shortly after taking office.

In addition, energy markets, like all other markets, have numerous other imperfections, which are relatively minor in comparison. These include, for example, "nonappropriability" benefits for long-term research and development, imperfect information, behavioral and institutional constraints such as simple human inertia and the somewhat diluted incentives of landlords compared with homeowners to improve energy efficiency, and capital availability constraints, which arguably increase the cost of conserving energy for low income individuals.

We do not believe that it is possible or even desirable for the government to compensate for every "market imperfection". The government has "imperfections" of its own, so it is only in textbooks where a flawless public sector can eliminate all imperfections in the market. Some imperfections are relatively minor. It would be bad public policy, for example, to leave oil controls in place and then rationalize massive public spending as a cost-effective means to promote conservation.

The Administration is acting to help correct the more important market imperfections through:

Eliminating controls on oil markets as noted above;

Financing high-risk, high-payoff R&D that would not otherwise be conducted by the private sector;

Providing incentives such as depreciation allowances and tax credits to accelerate replacement of energy-inefficient capital stock and to promote the use of renewable resources;

Providing information to users who are otherwise unlikely to be well-informed (e.g., small businesses, households).

Question 2. One of the major objections raised to the market approach in energy conservation is that no provisions are made for low-income households that do not have the capital to invest in energy efficient improvements. It is not certain whether the Community Development Block Grant approach will adequately address the needs of all low-income households desiring to make such improvements. What plans do DOE, and your office in particular, have to address the problems of these households?

Answer. The Administration has proposed that weatherization of low-income homes be included in HHS's Home Energy Assistance Block Grant Program and thus allow that up to 10 percent of the money going to each State can be used for weatherization of low-income homes. In addition, under HUD's Community Assistance Block Grant Program, weatherization is eligible for support.

Question 3. One frequent failure of the market place occurs when market signals do not reach the energy consuming public. Two well-known examples of this occur in situations where (a) utility bills are included in a tenant's rent, thereby lessening incentives to conserve on the part of the tenant; and (b) there are lack of incentives for builders to install energy-efficient improvements. What plans do you have to compensate for market limitations such as these, without imposing severe regulatory burdens on the private sector?

Answer. (*a*) Undoubtedly you have heard of the so-called landlord-tenant problem. This problem arises from the following dilemma that is inherent in the landlord-tenant relationship. If the landlord pays the fuel bill, the tenant is free to waste energy unjustifiably. If the tenant pays the fuel bill, however, the landlord has no direct financial incentive to make energy conservation improvements.

Over time, prospective tenants may learn to consider basic energy conservation features of buildings before deciding where to rent. This certainly should occur when a tenant has had an unfortunate previous experience. This will create an indirect incentive for landlords to make necessary conservation improvements.

Energy conservation in multi-family buildings is being enhanced by the trend toward condominium and cooperative ownership. In condominium and cooperative buildings, the owners are the tenants; hence, they can react to financial incentives to make investments as well as to use energy wisely.

It is also important to remember that multi-family buildings tend to use less energy per unit than do single-family homes. So even where the landlord-tenant dilemma cannot be overcome, the energy usage per unit is still less than for other types of housing.

(*b*) It is undoubtedly true that incentives to conserve energy are somewhat diluted by the tenant-landlord relationship, particularly in the short-run. But more should not be made of this problem than is warranted. For example, it is common practice in today's rental market (in contrast to, say, a decade ago when energy was less expensive) for tenants to ask about past utility bills. Apartments with lower heating bills can command higher rents; so landlords have incentives to improve their property to use less energy and builders have incentives to develop cost-effective rental property.

Similarly, it is obvious to owners of rental property that including utilities in a tenant's rent exposes the owner to a risk of escalating costs and provides the tenant with perverse incentives to hold down energy use, so the owner has more incentive today, than a decade ago) to avoid rental controls that include utility bills, to install separate meters for apartments where it is profitable to do so; or to charge a higher rent to cover his risk. In addition, there is other evidence that the private sector and state and local governments are dealing with the incentives created by higher energy prices. For example, several southern utilities are awarding a "Good Cents Home Label" to fuel-efficient homes and the State of Florida has a rating system which it uses in giving permits for new construction.

As noted in the answer to Question 1, we do not believe it is appropriate for the Federal government to step in with a new Federal program simply because someone has identified a problem. We believe it is appropriate to allow private institutions to deal with those problems as they now appear to be doing.

Question 4. Some energy experts maintain that under current tax incentive policy, existing credits for oil may be more generous than those available for residential tax credits and other energy conservation investments. Do you agree with these analyses? Please describe any plans you have to equalize these tax subsidies in the future.

Answer. In our view, it is not appropriate to focus on tax credits as if they provided some sort of scorecard which needs to be equalized for various forms of energy production and conservation. The tax credits by themselves provide an incomplete picture of the incentives and disincentives provided for efficient production and use. Consequently, we do not find analyses which focus solely on tax credits as very meaningful.

For example, in the past new tax credits were included in the budget to promote conservation, but at the same time price controls on oil were maintained which provided disincentives for conservation. Similarly, an analysis focused solely on tax credits overlooks other important parts of the Administration's conservation strategy.

Since the tax treatment is different for businesses and individuals, it is more appropriate to compare the tax treatment for oil production with that for industrial energy conservation investments. Under President Reagan's program for economic recovery, many industrial conservation investments will be eligible for accelerated depreciation in addition to the regular and energy conservation tax credits. These credits and additional deductions provide ample conservation incentives.

Oil production is handled differently. Most oil production is not eligible for percentage depletion. Instead, cost depletion must be used to account for the declining value of the property. This is a conservative approach that minimizes deductions. Furthermore, the Crude Oil Windfall Profit Tax results in sizable taxes for most domestic oil production. This tax is in addition to corporate income taxes and, in many cases, royalty payments to the Federal and State governments.

When comparing energy conservation with oil production, it is easy to see that energy conservation is given special tax incentives while oil production is subject to special taxation.

Question 5. In the past, DOE has conducted research regarding the use of tax incentives. What conclusions have you reached concerning the effectiveness of such tax incentives in promoting energy efficiency, and which income group has used these incentives the most?

Answer. Analyses of the effectiveness of tax credits are being performed as a part of the sunset review required under the DOE Organization Act. We expect to have results by the beginning of 1982.

The Internal Revenue Service (IRS), which administers the energy tax credits, has recently released "final" data covering Individual Income Tax Returns for 1978. The data can be summarized as follows:

At least 705 thousand taxpayers having annual income of $12,000 or less claimed the energy credit and spent $455 million for conservation and $5 million for solar investments.

At least 3.7 million taxpayers having annual income between $12,000 and $30,000 claimed the energy credit and spent $3.7 billion for conservation and $51 million for solar. The largest number of taxpayers within this group (1.3 million) had income between $20,000 and $25,000 and spent $1.3 billion on conservation and $24 million on solar.

At least 1.5 million taxpayers having an income over $30,000 claimed the energy credit and spent $1.2 billion for conservation and $69 million for solar.

Question 6. Recently, the Solar Energy Research Institute published a report entitled "Building a Sustainable Future." This data and analysis in the SERI report indicates that substantial energy savings may be achievable in industry, transportation, utilities, and in the residential and commercial building sectors through increased conservation and energy efficient technologies. The report further concludes that "The role of the Federal Government in achieving these (energy) goals need not be costly or oppressive." Do you agree with these findings? Do you plan to implement any recommendations contained in the SERI report?

Answer. I have not had an opportunity to read the SERI report. I understand that there are many different opinions regarding its value. When I have time to study it, I will most certainly consider its recommendations.

Question 7. DOE has announced its intention to promote long-term research and development of certain energy efficient technologies. What emphasis will you place upon long-term R&D of conservation technologies, including passive solar devices?

Answer. In the coming fiscal years, conservation programs will increasingly emphasize more generic research and development of high-risk, potentially high-payoff technology enhancements that the private sector is not supporting and is not likely to be willing to undertake. Specific areas of emphasis are:

1. In the building energy sciences, the interactions among space conditioning, water heating, lighting systems and building materials will be investigated.
2. Support the development of electric and hybrid vehicles, especially in the battery, controller and charger subsystems.
3. Support for individually sponsored energy inventions.
4. With particular reference to passive solar, one subject which deserves investigation is the use of phase change materials in energy storage walls.

PROGRAMS

Question 1. How do you plan to stimulate energy efficient investment in each of the following areas: the industrial and commercial sector; the residential

sector; and the transportation sector? What methods will be used for determining areas within these sectors where government involvement is needed?

Answer. It is no longer DOE's policy to provide direct stimulation to such investment. We believe the industrial and commercial sector will respond to energy prices. The President has removed controls on the oil markets and the Administration's Economic Recovery Program includes tax cuts and other tax incentives that will stimulate energy efficient investment in this sector.

In the residential sector, we are involved in and expect to continue the basic research and development that will provide better ways to retrofit existing buildings to save energy, and may give us new designs, materials and equipment for new buildings.

In the transportation sector, we don't plan any involvement because the marketplace will drive the automotive industry to provide energy-efficient vehicles. The depreciation schedules and tax changes proposed will accelerate this process.

To determine where government involvement is needed in these sectors, we shall first determine whether the research and development is likely to be done without government involvement and then prioritize on the benefits derived versus the regulatory burden and program cost.

Question 2. What is the status of the following DOE research projects: the Building Energy Perforance interim standards; the review of the Standards and Labeling program in response to cutbacks in the Appliance Efficiency Standards program; the DOE study of residential and commercial energy usage? What conclusions has DOE reached as a result of its investigations in these areas? How will the proposed budget cuts affect these programs?

Answer. The Administration has proposed that the Congress appropriate no funds for the further development or implementation of building energy performance standards or appliance energy efficiency standards. However, as required by existing law, DOE is pursuing the development of interim standards. With regard to BEPS, DOE is performing research related to the development of energy efficiency standards for new buildings. We do not expect to be able to issue those standards in the near future. With respect to appliance standards, DOE is still continuing the review of the technical and economic analyses upon which a final determination will be made.

This review was announced in the Federal Register on February 23rd. DOE has not reached any final conclusions regarding the Appliance Energy Efficiency Standards at this time, but in general we do not support mandatory standards for either appliances or buildings. Rapidly rising energy prices and the Administration's proposals for freeing up the play of normal market forces, continuing and improving investment incentives and bringing about economic recovery will foster the design and construction of more energy efficient buildings and appliances without budrensome federal regulations. Final congressional action has not been taken on the Administration's proposals in either of these areas. With respect to buildings, DOE will continue R. & D. of more energy-efficient technologies, and in the case of appliances we will continue to provide support for the energy-efficiency labeling program.

Question 3. Are you satisfied with the Residential Conservation Service (RSC), Building Energy Performance Standards (BEPS), and Appliance Efficiency Standards programs as they are presently authorized? Or, will you undertake efforts during this Congress to effect statutory changes in these programs?

Answer. We believe that energy-price decontrol and the resulting free-market pricing will strongly stimulate most consumers to use energy efficiently. The stringent regulatory nature of these programs raises severe concern. With regard to RCS, we are revising the rules to lighten the regulatory burden. The Administration has chosen not to submit specific proposals at this time to modify or repeal the authorizing legislation for these actvities. We are seeking authority to eliminate the funding for these programs through the budget proposals of the Administration for fiscal year 1982. Depending on pending congressional budgetary action, the Administration may give further consideration to seeking specific legislative changes.

Question 4. Do you perceive that there are any gaps in the ability of the private sector to provide energy consumption and price information to consumers? If so, where are these gaps? Also, do you have any plans to improve information distribution systems to provide this data?

Answer. We believe that energy-price decontrol and the resulting free-market pricing will strongly stimulate most consumers to use energy efficiently. CE will continue to provide information on product consumption of energy for appliances (in cooperation with FTC) and for automobiles (in cooperation with EPA and DOT). As a priority, CE will seek to effectively transfer energy technology information resulting from CE R&D programs to the private sector. We are in the process of consolidating information distribution programs to make them more effective and efficient.

ORGANIZATION

Question 1. Please describe the Sunset Review process as it applies to your office, specifically the timetable that you will follow and how the procedure will work with respect to conservation.

Answer. The Department of Energy has initiated a Department-wide Sunset Review effort, which includes all conservation programs. The Sunset Review for all Departmental programs will respond to the directives of Section 1002 of the DOE Organization Act (P.L. 95–91; 42 USC 7351). On January 15, 1982 as mandated by Title X of the Act, the Administration is expected to deliver the Sunset Review to the Congress.

The Assistant Secretary for Conservation and Renewable Energy is responsible for preparing draft materials for review pertaining to conservation programs. This information will be reviewed by the DOE Title X Coordinating Committee, under the direction of the Director of the Office of Policy, Planning and Analysis (PPA) and the Assistant Secretary for Management and Administration (MA), prior to its submission to the Secretary of Energy and final approval.

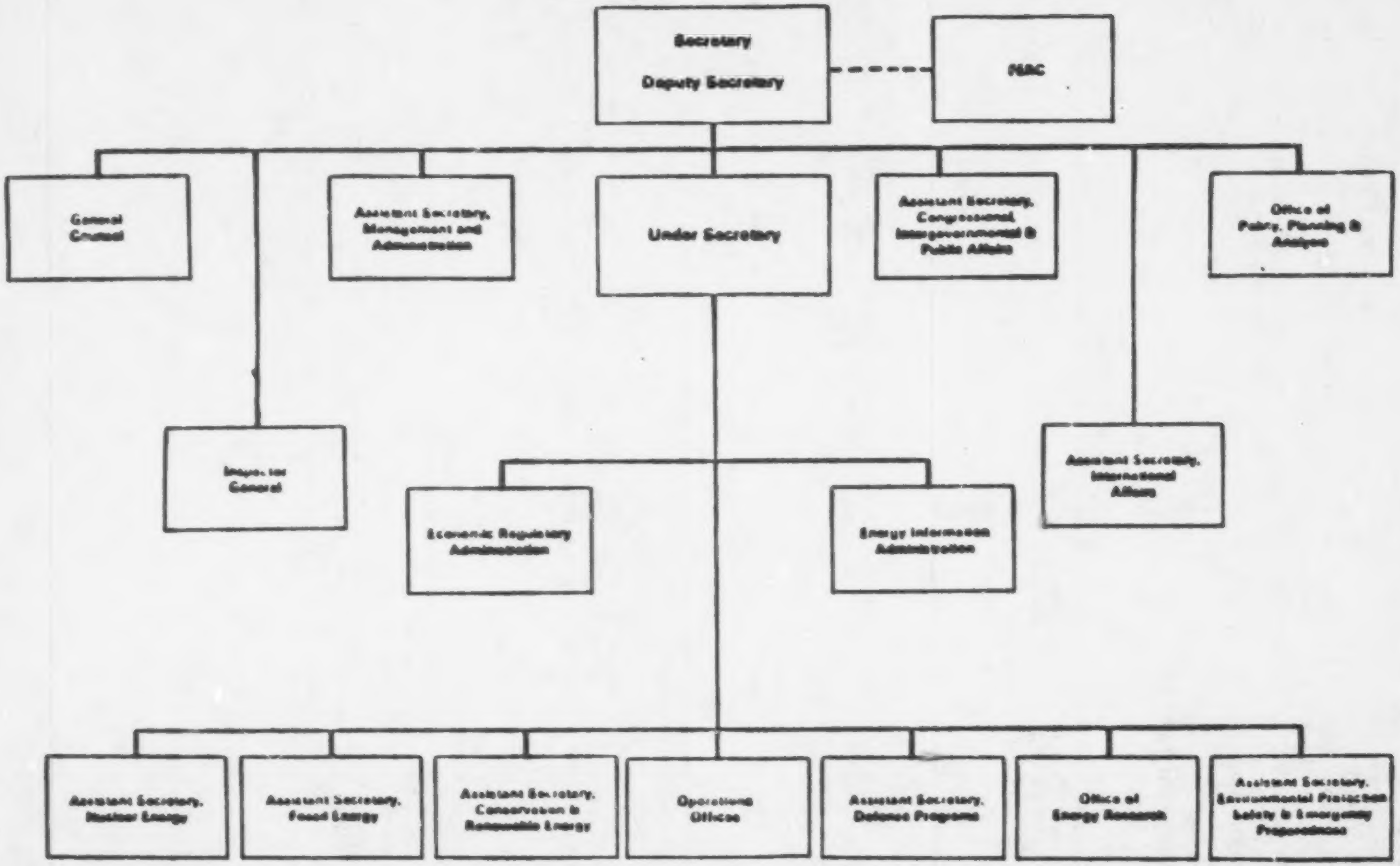
Question 2. Are there any conservation programs that you foresee being transferred from DOE to other government agencies or departments? If so, which programs are they? Where will they be transferred, and why? How will policy be determined in these cases, by DOE or by the new agency?

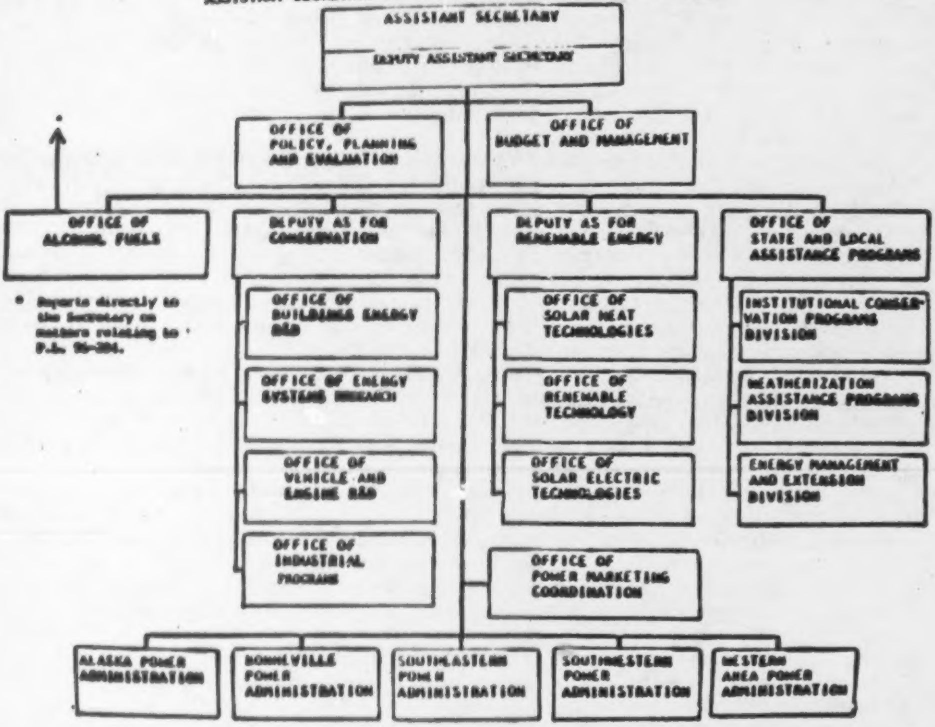
Answer. The Administration has proposed that the existing weatherization program in CE be eliminated and weatherization of low-income homes would become an eligible activity under both the HUD Community Assistance Block Grant program and the HHS Energy and Fuel Assistance Block Grant program. There are no other plans to transfer DOE programs to other government agencies at the current time.

Question 3. Please provide us with an up-to-date organization chart of the Department of Energy and the Office of Conservation. On the latter please identify other DOE offices what will be doing conservation-related work.

Answer. A current organizational chart of the Department of Energy and the Office of Conservation and Renewable Energy is enclosed. While the Deputy Assistant Secretary for Conservation is responsible for all conservation related research and development work we do provide financial assistance to support conservation activities by third parties, e.g., States, schools and hospitals, etc., through our Office of State and Local Programs. Additionally the Bonneville Power Administration has responsibility for conservation under the Pacific Northwest Electric Power Planning and Conservation Act (PL 96–501).

Department of Energy


Secretary
Deputy Secretary
NRC
General Counsel
Inspector General
Assistant Secretary, Management and Administration
Under Secretary
Assistant Secretary, Congressional, Intergovernmental & Public Affairs
Office of Policy, Planning & Analysis
Assistant Secretary, International Affairs
Economic Regulatory Administration
Energy Information Administration
Assistant Secretary, Nuclear Energy
Assistant Secretary, Fossil Energy
Assistant Secretary, Conservation & Renewable Energy
Operations Offices
Assistant Secretary, Defense Programs
Office of Energy Research
Assistant Secretary, Environmental Protection Safety & Emergency Preparedness



ASSISTANT SECRETARY FOR CONSERVATION AND RENEWABLE ENERGY

ASSISTANT SECRETARY
DEPUTY ASSISTANT SECRETARY
OFFICE OF POLICY, PLANNING AND EVALUATION
OFFICE OF BUDGET AND MANAGEMENT
OFFICE OF ALCOHOL FUELS *
DEPUTY AS FOR CONSERVATION
DEPUTY AS FOR RENEWABLE ENERGY
OFFICE OF STATE AND LOCAL ASSISTANCE PROGRAMS
OFFICE OF BUILDINGS ENERGY R&D
OFFICE OF ENERGY SYSTEMS RESEARCH
OFFICE OF VEHICLE AND ENGINE R&D
OFFICE OF INDUSTRIAL PROGRAMS
OFFICE OF SOLAR HEAT TECHNOLOGIES
OFFICE OF RENEWABLE TECHNOLOGY
OFFICE OF SOLAR ELECTRIC TECHNOLOGIES
INSTITUTIONAL CONSERVATION PROGRAMS DIVISION
WEATHERIZATION ASSISTANCE PROGRAMS DIVISION
ENERGY MANAGEMENT AND EXTENSION DIVISION
OFFICE OF POWER MARKETING COORDINATION
ALASKA POWER ADMINISTRATION
BONNEVILLE POWER ADMINISTRATION
SOUTHEASTERN POWER ADMINISTRATION
SOUTHWESTERN POWER ADMINISTRATION
WESTERN AREA POWER ADMINISTRATION

* Reports directly to the Secretary on matters relating to P.L. 96-294.

Question 4. Personnel in the Office of Conservation will be reduced from 670 to 448 employees by 1982. Where specifically will these reductions occur and according to what timetable? Also, are you planning a selective RIF of Senior Executive Service employees in that office?

Answer. The Office of Conservation and Renewable Energy is authorized 536 end of year positions in fiscal year 1981 and 456 full time equivalent staff years for fiscal year 1982 in Headquarters. The current on board strength is approximately 670 employees. We are in the process of assessing the impacts of the recissions/deferrals and, therefore, do not have at this time information as to how many or where reductions will occur. We expect some of the reductions to be effected by September 30, 1981. There will be some reductions in SES positions. At this point there are no regulations governing reductions in force of SES positions, but we understand that such regulations are forthcoming from the Office of Personnel Management.

RESPONSES TO WRITTEN QUESTIONS SUBMITTED BY SENATOR PERCY

Question 1. As I indicated in my opening statement, I agree with a free market approach to energy conservation, but feel strongly that this must be tempered with common sense. Can you think of instances where regulations are simple to implement, where their benefits are plain, and where they serve as an important national reminder of the need to conserve? The 55 mile per hour speed limit comes to mind in this regard.

Answer. Despite considerable thought we have been unable to think of energy conservation regulations which clearly fit these criteria.

Question 2. One of the major objections raised to the market approach in energy conservation is that low-income households are often unable to raise enough capital to invest in energy efficient improvements. It is not yet certain whether the Community Development Block Grant approach will adequately address the needs of all low-income households desiring to make such improvements. What plans does DOE, and your office in particular, have to address the problems of these households?

Answer. The Administration has proposed that weatherization of low-income homes be included in HHS's Low Income Energy Assistance Block Grant Program and thus allow up to 10 percent of the money going to each State to be used for weatherization of low-income homes. In addition, under HUD's Community Development Block Grant Program, weatherization is eligible for support. The Administration has indicated that it would not oppose an energy blolck grant which would include weatherization and other categorical grant programs, provided that the appropriation for such a program would be consistant with the Administration's program to reduce Federal expenditures.

Question 3. In response to our pre-hearing question about the lack of incentives for conservation in rental housing, you warned that "more should not be made of this problem than is warranted." We have a lot of rental housing in Chicago and other Illinois cities, and neither landlords nor tenants have much to gain—as things stand now—by investing in insulation or other conservation improvements. I think this is most unfortunate, especially in the case of low-income tenants who face ever-rising energy bills. In your response, you concluded that private institutions should basically be left alone to deal with this problem. Could you please explain what you mean by this, and why you feel this way?

Answer. The private sector is making significant progress in the area of rental housing, and clear signals have been sent to owners and operators of rental property that energy costs are a definite criterion for selecting rental housing. Energy-conscious tenants have implemented low-cost, no-cost measures aimed at reducing energy costs. Many leases now separate energy costs, placing more responsibility on the tenant for the level of energy consumed in his unit. New buildings are generally more energy efficient; many have separate meters. Energy costs are becoming more of a sales point for rental units, demonstrating that rising energy prices are raising awareness of the need to conserve energy. It is true that low-income persons are less able to make the economic adjustments involved in installing conservation measures; however, we do recognize this and cannot ignore their plight. There are a number of State, local and Federal programs aimed at providing them with appropriate assistance in both making the necessary investments and in paying increased fuel bills.

Question 4. At the July 21 hearing, Linda Gallagher of the Alliance to Save Energy made the point that energy conservation is subsidized less than energy production, as our tax laws stand today. The Alliance has taken the position that oil production, in particular, is favored over conservation. In a response to one of our pre-hearing questions, you made the opposite point—that "energy conservation is given special tax incentives while oil production is subject to special taxation." In general, do you think conservation fares as well as new energy production in our tax policies?

Answer. Our response to the pre-hearing question was made with "energy property" tax credits and the "Windfall Profits" tax in mind. Certainly tax considerations other than tax credits are relevant in answering these questions.

The Alliance to Save Energy drew their information from "Special Analysis G: Tax Expenditures," Budget of the United States Government, 1982, Office of Management and Budget, January 1981. This analysis includes a special presentation calculating energy tax expenditures on a fiscal year basis. While these tables include many of the tax provisions affecting energy conservation and supply, they are by no means comprehensive in their treatment, treating as they do only exemptions to the normal income tax structure. Specifically no consideration was given to the special taxes levied on fossil fuels.

As the following numbers show, the picture looks substantially different if for example, net windfall profit tax receipts (from page 347 of the 1982 Budget Document) are considered together with the Special Analysis G information.

Fiscal year 1982

	In millions
Conservation tax credits	$895
Supply tax credits	10, 875
Less WPT receipts	19, 897
Net	−9, 022

Question 5. Under the proposed DOE budget, funds for the State energy offices will no longer be available, and most of these offices will be eliminated. At a Subcommittee hearing held May 1 on Community Emergency Preparedness, Frank Beal, the Director of the Illinois Institute of Natural Resources, submitted testimony expressing grave concern over the future of important State and local energy programs that may no longer be administered without the State energy offices. A number of legislative proposals have been introduced to promote the continuation of state conservation efforts—including a bill which I have co-sponsored, the National Home Weatherization Act. What, in your opinion, would be the best approach to developing a strong state and local conservation program?

Answer. In my opinion it is not the responsibility of the Federal Government to see to it that strong State and local conservation programs exist. The needs of the states vary widely in this regard. State and local governments are generally responsive to the needs of their constituents. If a conservation program is high on the priority list of services to be performed it could be financed by the State or locality, displacing, if necessary, services of a lower priority.

Question 6. You stated in your response to our pre-hearing question that you have not yet had the chance to read the SERI report. I urge you to read that report, for although neither you nor I would agree with all its contentions, it provides an interesting and useful counterpoint to the case made by the Administration in the National Energy Policy Plan. I would like you to get back to me within 30 days with your reactions to the specific recommendations in this report. Is this possible?

Answer. During the next 60 days we will review all the programs under my jurisdiction. We will attempt to fit them into a Management By Objective System, taking into consideration the overall objective of each program, its current status, its funding level for fiscal year 1982, Administration policy guidelines, and potential progress in fiscal year 1982. As we do so, we will consider the portion of the SERI report which deals with each program. We believe this plan will enable us to make the best use of the SERI report.

Question 7. I have one other question about the Solar Energy Research Institute. I accept the fact that DOE is reducing the level of SERI's activities, yet I am concerned about a fundamental change in the direction of SERI's activities. I have heard that DOE is directing SERI to phase out its international projects. I hope that this is not true, because the assistance that SERI has given in the international field has been essential to the successful application of solar technology in a number of areas, especially in the developing world. SERI's efforts in this realm have rarely duplicated anything that the private sector could have done. What is DOE's policy towards SERI's involvement in international projects?

Answer. There will be no prohibition per se against international activities being conducted by SERI for DOE or other Federal agencies. In keeping with the reorientation of the Department's budget toward longer-term, high-risk research and development activities, the Solar Energy Research Institute resources have been redirected toward research and development, away from those commercialization-type activities better handled by the private sector. Many of the international program being handled by SERI were of the commercialization type and they in fact are being terminated. International activities in which SERI will participate in the future will be those which have a direct relationship to programs which are being handled by SERI for the Department of Energy or other agencies.

Question 8. On April 2, Energy Secretary Edwards testified before this Subcommittee regarding the reorganization at DOE. In response to pre-hearing questions submitted to the Department, Secretary Edwards noted several in-house efforts at DOE to promote energy efficiency in the development of a federal energy management plan, a review of federal agency building operations plans, and the preparation of federal energy reports to keep Congress informed as to the status of federal conservation and energy efficiency programs. What is the current status of these in-house conservation programs. Has any progress been made since our April meeting?

Answer. The review of Federal agency buildings and general operations plans is continuing. The report to the Congress required by the Energy Policy and Conservation Act (P.L. 94–163) and a consolidated report to the President on energy management in the Federal Government are in the final stages of internal review. This consolidated report will also be provided to the Congress to fulfill the report requirements of the National Energy Conservation Policy Act (P.L. 95–619). The Federal 10-year buildings plan to comply with Executive Order 12003 is nearing completion of internal review. Updates of Federal life-cycle cost guidelines have been completed and are presently at OMB for approval.

Question 9. Please provide the subcommittee a list of international projects currently underway at SERI. Indicate for each project if the project will be continued at SERI in the fuure; if it will be picked up by another agency (which agency?); or if it will be cancelled altogether (please indicate when and justification).

Answer. At the present time, SERI is managing the U.S./Saudi Arabian Agreement in Solar Energy, SOLERAS. A number of programs—specific international activities with Israel, Mexico and the International Energy Agency will continue but will be managed directly by the DOE program offices concerned rather than through SERI. This will eliminate unnecessary layering of project management responsibility.

Question 10. SERI apparently will be reduced significantly in size and scope of activities. Please provide the Subcommittee a list of current R&D activities at SERI and indicate which of these activities will be continued n FY 1982 and which will be cancelled. In addition, please provide a list of all current commercialization activities at SERI which will be cancelled.

Answer. SERI's current and fiscal year 1982 planned R&D activities are as follows. Zero funding in fiscal year 1982 indicates that the activity will not be continued at SERI.

[Dollar amounts in thousands, fiscal years]

Program	1981 estimated	1982 planned
Active heating and cooling	$7,800	$1,200
Passive heating and cooling	3,500	1,300
Photovoltaics	29,100	15,000
Building applications	700	(1)
Solar thermal	5,200	3,900
Biomass	5,600	5,600
Industrial applications	800	(1)
Wind	3,700	1,500
Ocean systems	2,300	0
Solar power applications	900	(1)
Buildings and community systems	1,500	0
Solar energy storage	1,200	1,000
International (except Soleras)	1,900	0
Information systems	4,800	3,200
Analysis	2 600	(1)
General research	2,400	(1)
Alcohol fuels	8,000	8,000
Energy research	900	800
Policy and evaluation	400	0
Soleras	15,500	(2)
Total	98,800	41,500

[1] In fiscal year 1982, funds for these tasks are included in each technology area as appropriate.
[2] To be determined.

DOE has recently completed a review of all SERI fiscal year 1981 activities with respect to current Administration policies. Non-R&D activities were identified and recommended for either redirection to R&D, termination, or to be brought to an orderly conclusion.

The following is a listing of current commercialization projects at SERI that are being terminated:

Active Solar: Denver Metro Project; Residential Conservation Service (RCS); Building Energy Performance Systems (BEPS); and Analysis and Technical Support.

Industrial Applications: Energy in Industry.

Buildings and Community Systems: Building Industry Support; Commercial Apartment Conservation Service (CACS); and Technical Support/Assistance.

Analysis: Community Planning and Legislative Support.

The following projects are being brought to an orderly conclusion:

Active: Residential Incentives Analysis; Federal Buildings; Schools and Hospitals; and Codes and Standards.

Passive: Solar Cities & Towns Economic Analysis.

Photovoltaics: PV Quality Assurance and Standards Development and Residential PV Experiments.

Building Applications: Solar Law Reporter.

Solar Thermal: IPH Field Test; and Technical Planning and Assessments.

Industrial Applications: Financing of Industry Solar Projects; Solar Applications; and Regional Conventional Fuel Prices.

Wind: Analysis and Planning and Wind Information Networking.

Solar Power: Planning and Review.

Building and Community Systems: Residential Energy Efficiency Program; Building Industry Support; and CACS Technical Support/Assistance Rulemaking.

International: International Market Development.

Information Systems: Inquiry Referral.

Analysis: Community Planning.

Alcohol Fuels: National Alcohol Fuels Information Center.

Policy and Evaluation: Renewables Modeling and Data.

Question 11. The Office of Conservation and Renewables has, according to your testimony, had under review existing conservation information dissemination systems in an effort to streamline these systems. Please provide the Subcommittee a list of existing information dissemination systems in the conservation and renewables area; their primary functions; major overlaps; and the changes you are considering in the systems to streamline them.

Answer. As part of a continuing review and analysis of CE information dissemination systems to improve their overall efficiency and effectiveness, the following table identifies the major systems and the actions taken to improve them.

System	Primary functions	Major overlap	Actions taken
Solar Energy Research Institute (SERI).	Operation of Solar Energy Information Center.		Redirected this program to handle only technical information related to SERI activity.
	Development and maintenance of on-line data bases.	Overlap with Technical Information Center (TIC) in bibliographic data base.	SERI bibliographical services terminated. Consolidated at TIC.
	Inquiry and referral services related to solar technologies other than heating and cooling.	Overlap with other CE inquiry and referral systems.	Terminated all inquiry and referral services at SERI. Consolidated at CAREIRS.
	Conducted information dissemination and outreach activities.	Overlap with other CE dissemination and outreach activities.	Terminated these SERI activities. Redirected effort to development of R. & D. information products for priority audiences.
Conservation and Renewable Energy Inquiry and Referral Services (CAREIRS, formerly National Solar Heating and Cooling Information Center).	Inquiry and referral services directed to residential solar heating and cooling (SHAC).	Overlap with other CE inquiry and referral systems.	Consolidated all solar and renewable energy inquires at CAREIRS.
	Conducted SHAC workshops and conferences.		Terminated these types of activities.
Regional Solar Energy Centers (RSEC's).	Commericalization of near-term solar technologies at regional level.		RSEC activities directed to support solar R. & D. information transfer.
	Inquiry and referral services related to all solar technologies.	Overlap with other CE inquiry and referral systems.	Inquiries to be referred to CAREIRS.
President's Clearing House.	Inquiry and referral services directed to public officials.	Overlap with other CE inquiry and referral systems.	Activity terminated in June 1980. Inquiries may be processed by CAREIRS.

RESPONSES TO WRITTEN QUESTIONS SUBMITTED BY SENATOR GLENN

Question 1. **Mr. Secretary, you have many years of experience in the industrial sector. In your opinion will the incentives offered to industry by this Administration, such as lower taxes, more rapid depreciation, etc., stimulate industry to invest in new, innovative technology developments or will such monies be spent on modern, but conventional technology? Would Union Camp, for example, have invested in developing and installing the cold corrugation process currently funded by the Department of Energy through the Institute for Paper Chemistry?**

Answer. Any well managed industrial business which expects to compete successfully must innovate. In the era before high taxes, excessive governmental regulation and before tax credits, U.S. industry led the world in innovative technological development. (See also answer No. 4 below.) I firmly expect that the President's economic recovery program will stimulate much greater private sector investment in new technology development. My former employer is a divisionalized company. The development inquired about took place in a division other than the one in which I worked. I have no knowledge of the economics which justified it. I am familiar with other more innovative and more costly developments which have been undertaken without government participation.

Question 2. In many industries such as pulp and paper, the plant manager's primary concern is assuring that his production meets the output goals established by the corporation. In your experience would such a manager be willing to jeopardize his output by installing a new unproven process technology without some external funds helping to share the risk of production loss?

Answer. Many plants are profit centers within a company or within a division of a company. There are several primary concerns; safety, quality, production and cost. Most new unproven process changes are generally implemented in such a way that total production will not be affected. Even so, the plant manager would have the approval of senior management and a joint commitment would be made to accept the risk.

Question 3. Many in the paper industry have expressed a need for Federal assistance in new process development. Dr. Robert Myers, vice president of St. Regis, for example, testified last year before the House Science and Technology Committee that the new hydropyrolysis process for black liquor reduction would never be attempted without Federal funds. In light of the Administration's position of zeroing the industrial conservation budget, what industry mechanism could be instituted to take up the slack?

Answer. The new depreciation schedule, lower tax rates, and tax credits proposed by this Administration should provide adequate incentive for this type of development, particularly in view of energy price deregulation.

Question 4. As a power plant engineer at Union Camp what would the price of oil have to go to before you would recommend to your management installing an advanced cogeneration system such as the fluidized bed indirect fired gas turbine system?

Answer. In 1978, the price of residual oil was approximately $12 per barrel. At that time I recommended a cogeneration system comprised of a high pressure steam boiler and turbine generator. The system (now under construction) is innovative in the following ways:

(a) Steam conditions are 1,800 psig, 1,000° F—a first for U.S. industry.
(b) Principle fuels are pulverized coal and hogged waste wood.
(c) The system will be remotely controlled by computer.
(d) Cost—on the order of $100 million.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY SENATOR JACKSON

Question. Strong bipartisan congressional action (P.L. 96–501, the Pacific Northwest Electric Power Planning and Conservation Act of 1980) has provided important electric energy conservation tools to the Pacific Northwest and placed significant new regional electric energy conservation responsibilities on the self-financed Bonneville Power Administration.

This Administration has stated its intention to rely on market forces to achieve cost-effective energy conservation. The Bonneville Power Administration is a major electric energy market force in the Pacific Northwest. May I have your assurance that you and the Department will continue to assist the electric rate-payers of the Pacific Northwest to achieve cost-effective electric energy

conservation by helping Bonneville to implement the conservation provisions of P.L. 96–501?

Answer. I am pleased to assure you that the Department, and my office in particular, will work closely with the Bonneville Power Administrator to assist him in every appropriate way to achieve cost-effective energy conservation for the Pacific Northwest, as directed by the conservation provisions of P.L. 96–501.

Senator GLENN. The next panel which we will have—we will have a break after I introduce them—is Miss Linda Parke Gallagher, executive director of the Alliance to Save Energy; Hon. S. David Freeman, board of directors of TVA; and Robert H. Williams, senior research physicist of the Center for Energy and Environmental Studies of Princeton University.

We welcome you this morning. As soon as we get some people back here, we will proceed. We will stand in temporary recess.

[Brief recess.]

Senator PERCY. I would like to introduce a panel of distinguished energy experts. Linda Parke Gallagher, executive director of the Alliance to Save Energy, which has been promoting energy conservation since it was formed 3 or 4 years ago; Prof. Robert Williams, senior research physicist with the Center for Energy and Environmental Studies of Princeton University, and author of a recently published book "Our Energy: Regaining Control"; and finally, Mr. David Freeman, currently on the board of directors of the Tennessee Valley Authority, who had a prominent role in developing the Carter administration's energy conservation policies.

We are just delighted to have the three of you join us today. We look forward to your testimony. Ms. Gallagher, if you would begin. To the extent that you can, please summarize your testimony. The complete testimony will be incorporated in the record.

TESTIMONY OF LINDA PARKE GALLAGHER, EXECUTIVE DIRECTOR, ALLIANCE TO SAVE ENERGY: S. DAVID FREEMAN, BOARD OF DIRECTORS, TENNESSEE VALLEY AUTHORITY; ROBERT H. WILLIAMS, SENIOR RESEARCH PHYSICIST, CENTER FOR ENERGY AND ENVIRONMENTAL STUDIES, PRINCETON UNIVERSITY

Ms. GALLAGHER. Thank you, Mr. Chairman. I would like to request that my statement be put in the record and I will just highlight my comments for you.

Senator PERCY. Fine.

Ms. GALLAGHER. I would like to begin by directly responding to Assistant Secretary Tribble's testimony of this morning.

Specifically, we at the alliance have also reviewed the national energy plan which was sent in July to the Hill. There are a number of ways in which we do agree with this policy document, especially its emphasis on efficiency improvements rather than sacrifice, its commitments to oil decontrol and rising energy prices, and recognition that energy efficiency is going to require large capital investments on the part of both businesses and individuals. So to this end we very much support the Reagan administration's emphasis on economic revitalization and on tax cuts for businesses and also for individuals.

We do think that some of these capital resources will certainly be invested in energy efficiency improvements. But at this point I must add that we do think that the administration does not go far enough in recognizing energy conservation's essential role in national security, in economic revitalization, and in recognizing that the goals of economic productivity and energy productivity are barely distinguishable.

Further, as was so well pointed out today, the massive budget cuts that were leveled at the conservation area of the Department of Energy's budget were greatly disproportionate to the cuts leveled at any other area of the Department's budget.

In addition, we think that the plan has an unrealistic view of the energy marketplace of today. This is not a free energy marketplace that we are operating in. As you have pointed out, and I underscore in my testimony, energy production—and this is particularly oil and gas—is currently subsidized and will be in 1981 at 12 times the level of energy efficiency. In addition, price controls remain on natural gas and, of course, the entire electric utility industry is heavily regulated.

I just want to underscore that these are not free market conditions. There are a number of imperfections or gaps in the marketplace which we think should be addressed by a national energy policy.

The alliance staff has laid out in a major policy paper which we have prepared and will make available shortly to this subcommittee, a paper entitled "Towards a Free Market in Energy." [1] We have identified a number of specific initiatives for Federal energy policy, which we think will provide the necessary transition toward a free market in energy. We think Government has an established leadership role in this transition, and that it is achievable by the nineties. But we think that we are right now in a transition period which will, in the short run, require a number of Government interventions. The major elements of this strategy are threefold. I will identify them briefly.

The first is the immediate decontrol of old and new gas.

The second is equalization of tax incentives and direct outlays for energy conservation with those for energy production. We have identified, and certainly many other studies have also, the level of productive investment which could be made in energy conservation. It runs as high as $400 billion over the next 10 years. So we think that there is a very productive role for Government in stimulating, through tax incentives, the development of this industry.

The third policy recommendation is that we place a so-called windfall profits tax on old gas at the time that it is decontrolled and that these revenues be used to equalize the incentives for energy efficiency and that they also be used to help lower income families adjust to this free marketplace, which, of course, will involve rising energy prices.

We support the position of the Reagan administration in allowing a portion of HHS money to be used for low-income energy conservation assistance.

So, in summary, we believe that the critical role of Government in the eighties is to build the bridge toward the free market philosophy. We favor equalization of incentives until about the late eighties, at which time we would favor phasing out of all incentives for all forms of production so that we may enter the nineties with all forms of energy on a more equal footing, able to compete for the consumers' energy dollar.

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[1] The publication referred to has been retained in the subcommittee files.

We support the role of Mr. Tribble as a strong advocate for these and other ideas and express our willingness to work very closely with him. Thank you, Mr. Chairman.

Senator PERCY. Thank you very much indeed.

We do look forward very much to the alliance's forthcoming study on the energy marketplace, "Towards a Free Market in Energy."

I am pleased to note the presence of Mr. Rauch, a very valued member of the staff at the alliance.

Dr. Williams, we are pleased to have you join us today. Your past work in the field of energy conservation is certainly well known. It has benefited all of us a great deal in this field, particularly in the residential sector. Your new book, "Our Energy: Regaining Control," offers a very significant analysis of current imperfections in the energy marketplace. We look forward to your testimony.

Mr. WILLIAMS. Thank you, Senator. I would just like to hit a few of the highlights of my detailed statement.

In our book, "Our Energy: Regaining Control," Professor Ross and I have focused on a market-oriented approach to energy conservation. We have concluded that if life cycle costs are minimized in decisions relating to energy supply and conservation, energy use could be reduced over the next 20 to 30 years some 15 percent or more below the present level, along with a growing GNP. But to accomplish this, many more policy initiatives are needed than are provided for in the market strategy that has been advanced by the administration, because of a wide range of market imperfections.

We categorize the measures that are needed in five categories: First is rationalizing the price of energy. Second is improving the flow of information. Third is fostering the creation of an industry that sells saved energy. Fourth is protecting the poor against the burden of high energy costs. Fifth, supporting research on energy efficiency.

Ms. Gallagher has already pointed to a few measures in these areas, so I will focus on some of the measures that she has not mentioned.

In the area of rationalizing the pricing of energy, we should be moving toward the creation of market conditions where consumers see the full social costs of energy production and use. This involves three types of initiatives. One is to speed up the deregulation of gas prices and consider deregulation of electric power generation as well. Second is to eliminate entirely subsidies for both the routine provision of energy and for the commercial demonstration of new energy supplies. Third is to levy an energy tax that would take into account externalities, such as national security costs and environmental impacts, that are not accounted for in existing energy prices and to use the tax revenues to offset existing taxes—such as social security taxes and corporate income taxes—or to rebate the revenues directly to consumers in one way or another.

In the area of improving the flow of information, I will draw attention to one set of measures that I think is particularly important: The extensive use of labeling laws for energy-intensive activities throughout the economy. These would be not regulations of energy performance, but regulations that give the consumer the kind of information he needs to minimize costs in decisions relating to energy. I will give three or four examples here:

We already have labels for certain energy-intensive appliances. These labels should be extended to buildings—both new and old buildings at the time of sale. They should be extended in the transportation area to items such as lubricating oils and tires. If we were to replace the existing oils and tires with the most efficient products on the market today, a fuel savings of some 1 million barrels of oil per day could be achieved by about 1985.

In the third area, which involves fostering the creation of an industry that sells saved energy, one needed change relates to industrial cogeneration. I am persuaded that if cogeneration is to become a major energy-saving option for the Nation, it is important to foster utility ownership of cogeneration facilities. I would suggest that the PURPA legislation be amended to give equal treatment to all forms of ownership, as far as the benefits of cogeneration are concerned.

A second example in this area is to come up with a market-oriented strategy for the promotion of energy efficient cars. It is cost effective and technologically feasible to move the fleet average of new cars to 60 miles or more over the next 10–15 years. Yet, Detroit has given no significant indication that it will go beyond a fleet average of about 23 miles per gallon, which would result from the imposition of the 1975 mandated new car fuel economy standards.

One way to push Detroit toward a much higher fuel economy standard would be to provide tax incentives on a per car basis in proportion to the improvement in fuel economy relative to the sales weighted average for all cars. The revenues for such a tax credit could be obtained by earmarking a small part of a tax that might be levied on gasoline or imported oil. If we had a $20 a barrel tax on imported oil, for example, the revenues over a 10-year period would be some $360 billion. A tiny fraction of that would be enough to permit the retooling of Detroit to meet a 60-mile-per-gallon goal.

Turning now to the fourth area, if an energy tax of some kind is levied, there are various ways in which the revenues could be returned to the economy so as to protect the poor. For example, in the case of a gasoline tax that is rebated equally among adults, the poor would generally come out ahead because poor households usually drive much less, if they have cars. And many poor households do not have cars. If a tax were instead levied on all oil, a more progressive rebate may be more desirable, because the typical poor household consumes almost as much oil as the average household.

Finally, we should pay much more attention to R. & D. on energy efficiency for the long term. We are very low on the learning curve as far as energy efficiency is concerned. Back at the turn of the century, electric powerplants were about 4-percent efficient. Now they are 32-percent efficient on the average. In the area of energy efficiency, we are way back where we were at the turn of the century, with electricity and energy supply technology generally. We should not regard energy conservation as a stopgap measure. If we give strong support for R. & D., the conservation opportunities will continue to unfold for many decades to come. Thank you.

Senator PERCY. Thank you very much, Dr. Williams.

Mr. Freeman, we all look upon you as a real pioneer. Long before we got religion, you had it already. You have been a leading spokesman for conservation during the seventies. You are the principal author of the Ford Foundation Energy Study, a landmark study, and later you were key draftsman of the Carter administration's first energy plan. We certainly look forward to your testimony. A complete copy of your testimony will be incorporated in the record.

Mr. FREEMAN. Thank you, Mr. Chairman. If I might say, I can recall working here in the Senate when you were virtually alone and couldn't get anyone to cosponsor even a 1-cent tax on gasoline. So when you mention pioneers in this field, you certainly have been advocating energy conservation long before "most people could spell the word."

I am delighted to be here. I realize the hour is late. I would like to submit my testimony. I shan't even try to summarize it.

I would like to make just one point after hearing the testimony this morning. I believe that the emphasis on market forces is certainly appropriate, but I would like to say this, on the basis of 4 years of experience on the firing line trying to help run the Nation's largest utility system. The market forces are heavily tilted in favor of production. The access to capital which the average utility company has, not to mention the average oil company, would make the average consumer green with envy. There is just no comparison between the amount of money going into drilling for oil and gas, into building powerplants, into every form of production, compared to the resources of the average business person, who is strapped for capital by these high interest rates, not to mention the average consumer.

Our experience is that when you get away from the energy-intensive companies, who have done a tremendously good job, you find that the average business person or homeowner isn't even able to make the investment in an energy audit. After having had their home audited, they would not ordinarily make the investment in conservation but for, in our area, TVA's front-end loan program where they pay back conservation loans on their electric bills.

It is not just a question of imbalance in tax credits. I agree with Linda's analysis there. It is a fact that capital is available on terms at the production end that just isn't comparable to the terms at the consumption end. There aren't that many people out selling energy conservation. The average business person is having a hard time raising the capital to stay in business. They are not in the energy conservation business.

If we are worried about inflation in this country—and we all are—there is nothing more anti-inflationary than putting a dollar into conservation that will save two, three, four, five times what every dollar will save that goes into production. It is not just a question of national security, which I think is still very much at the heart of the problem, as we import oil by necessity rather than choice. It is not just a question of the environment, which is degraded by production and not by conservation. It is a question of fighting our No. 1 economic enemy, inflation.

For that reason, my testimony urges that we go a whole lot further in tax credits for conservation and tax credits for people who invest in conservation R. & D., because without that, we are going to continue to inflate the economy with investments in production and not make necessary investments in conservation. Even the business people who are investing in conservation demand a 4- or 5-year payout. TVA is building powerplants that require a 20-year payout. That is the reason we have to set an example by investing in conservation.

But we are virtually alone in that. Certainly the rest of the energy production industry is interested in production and not in conservation. So my plea to the Congress is that in revising the Tax Code, I hope you will recognize that that is a powerful stimulus to bring the payout in conservation down to the level where the necessary investments will be made. There is nothing more anti-inflationary that we could do than to enhance the incentive for investments in energy conservation.

Thank you, Mr. Chairman.

Senator **Percy**. Thank you very much indeed.

Just one question to you. Then I would ask, because I am 10 minutes late for a meeting with the majority leader now, that the other questions be incorporated in the record. Bill Strauss, our staff director, will give you copies of those questions before you leave today. They will keep the record open for you.

When I questioned Secretary Tribble, I noted the national energy plan projections that net oil imports would be 6 to 7 million barrels per day in 1985 and 4 to 5 million barrels a day in 1990. Do you agree with those projections? Do you think we should be doing, and could be doing, much more as a nation to avoid the continued importation of that much oil, projected as far ahead as 1990? Are there things that can be done to bring those levels down and set a more desirable objective and goal?

Dr. Williams?

Mr. **Williams**. I think we can do much better than that, but it requires, of course, as all the witnesses have said, much more in the way of public policy initiatives. If you take just one of the proposals I made here, and that was for some strategy to push automotive fuel economy much higher, I think we can save in that area alone some 0.6 million barrels per day by 1990, and, by the turn of the century some 2½ million barrels of oil per day. In the area of space heating for residential and commercial buildings, we can save another 1½ million barrels per day of oil equivalent over the next 10 or 15 years.

Such savings are both desirable from the point of view of national security and cost effective from the point of view of the consumer. But these savings are not going to be achieved unless we make markets work a lot better than they do today.

Senator **Percy**. Thank you. Miss Gallagher?

Ms. **Gallagher**. Yes. I would agree with Dr. Williams completely. I would just defer to our policy paper, "Towards a Free Market in Energy," which offers a whole range of Government initiatives which we think would bring these estimates down much, much lower.

Senator **Percy**. Thank you. Mr. Freeman?

Mr. **Freeman**. There is just no question that we can do better, and in my opinion we must. Just for one example: We could decide today that we will have a fleet average of 60 miles per gallon in automobiles by 1990. It means perhaps going into partnership with Detroit in terms of retooling. It might be just the very thing that will not only save the country, but it might even be the only thing that we could possibly do to keep the automobile industry competitive in the 1990's.

I think if it had not been for the Congress enacting the Fuel Economy Act in 1975, the automobile industry would be in even worse shape today than it is. It seems to me rather than regulation, a program of financial partnership to retool for the much more fuel efficient car, that one step alone could knock our oil import volumes down by several million barrels a day by 1990 and could be the difference between this country's freedom of action in foreign policy and continuing to have our foreign policy twisted by this dependence on a handful of people for an oil supply.

Senator **Percy**. Thank you very much indeed. We are most grateful for your testimony. We have benefited from it. We will appreciate answers to the questions that are submitted to you.

[The prepared statements and responses to written questions of Ms. Gallagher, Mr. Williams, and Mr. Freeman follow:]

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STATEMENT OF
LINDA PARKE GALLAGHER, EXECUTIVE DIRECTOR
ALLIANCE TO SAVE ENERGY
BEFORE THE
SENATE SUBCOMMITTEE ON ENERGY, NUCLEAR PROLIFERATION AND GOVERNMENT PROCESSES
OF THE
SENATE GOVERNMENTAL AFFAIRS COMMITTEE

July 21, 1981

Good morning. My name is Linda Parke Gallagher and I am the Executive Director of the Alliance to Save Energy. The Alliance was founded in 1977 by Senator Charles H. Percy with Senator Hubert Humphrey. It is a bi-partisan coalition of leaders representing industry, labor, government, consumer and environmental organizations. The sole purpose of the Alliance is to bring about a national commitment to the more efficient use of our energy resources. The Alliance's activities focus on educating American consumers about the need and the opportunities to save energy. We also advocate policies to accelerate the delivery of efficiency improvements in the residential, commercial, industrial and transportation sectors of the economy.

I appreciate the opportunity which this subcommittee hearing offers to suggest new, cooperative public/private sector initiatives which will permit a balanced national energy program to be adopted. We believe that such a program is desirable, but will only be achieved if substantial resources are expended on energy efficiency as they have been expended on the development of traditional sources of supply. My testimony today will focus on the market imperfections which have created "gaps" in current national energy policy which prohibit energy efficiency from competing on an equal footing with other forms of energy supply. We believe that federal energy policy has not as yet come to recognize that a barrel of conservation energy is the cheapest, most environmentally safe and easily tapped source of supply that America has available to it in the short term.

Before I identify the energy policy gaps which are retarding conservation, I would like to stress that the Alliance does not oppose any form of energy supply. We believe that the country should be vigorously pursuing the development of new and diversified energy supply options. It is clear that our energy future will be one in which a great variety of supply sources compete for the consumer's dollar. However, in our transition to more diversified energy resources, we should be equally attentive to investments which will permit these energy resources to be used more efficiently.

As we begin the 1980s, we face market conditions which, if not understood, might lull some into thinking that our energy crisis has ended. Newspapers carry accounts of oil "glut" conditions in which supplies of crude oil are abundant and demand has abated. It is true that we are in a situation in which, due to Presidential actions decontrolling the price of crude oil, prices have jumped significantly and demand has declined. Compared with a 1977 import level of 8.5 million barrels of crude oil per day, we imported

6.3 million barrels per day last year. In the first six months of 1981, imports are down more than 20 percent compared with 1980. These results represent significant progress. However, we must keep in mind that foreign oil imports at the level of five or six million barrels per day represent an annual oil bill of over 70 billion dollars, lost domestic economic activity, and continued national security risks. Saudi Arabia and the volatile Persian Gulf area continue to hold the key to the western democracies' economic well being.

The challenge before us is how to create a national energy policy which can, on the one hand, move toward a greater reliance on free market forces, and simultaneously insulate the economy from another oil shock. Part of the answer lies in building up the strategic petroleum reserve, part in developing new domestic forms of supply and part in putting in place policies which will cause greater investment to occur in energy conservation. While we applaud the Administration's acceptance of a "free market in energy" philosophy, there are strong indications that it is less enlightened about conservation's essential role.

A review of recent actions by the Reagan Administration sheds some light on the limited role which it perceives for conservation in energy policy. We endorse the support for removing price controls and making capital available for end-use investments by individuals and businesses through tax cuts. This seems to indicate a sensible approach, viewing conservation as energy efficiency, not as sacrifice. We also are encouraged that the Administration supports the use of the Department of Health and Human Services' low income energy assistance monies for conservation measures, including furnace retrofits. However, we see other indications that conservation's role is actually diminishing in national energy policy. Let me be specific. The Department of Energy conservation budget has been drastically reduced. Far deeper cuts have been leveled at this program than at other energy program areas. The Administration proposes to eliminate, through lack of funding, the residential conservation service, and programs such as appliance standards, weatherization, commercialization, information and short term research. The ten percent energy investment tax credit has been extremely narrowly interpreted by the Internal Revenue Service with no support for broadened definitions from any Energy Department or other Administration official. The credit for energy efficiency investments expires in 1982, eliminating the only targeted federal financial assistance for energy efficiency for business. The movement toward greater energy efficiency will not curl up and die as a result of this thoughtless lack of nurturing, but will be severely stymied from reaching its full potential.

To correct this undervaluing of energy efficiency, we suggest the Administration continue to pursue general economic revitalization, but that it recognize the inequities that now exist in federal treatment of conservation vis-a-vis other forms of supply. Further, a half-century of cheap and abundant oil and gas has created market imperfections which make federal intervention on behalf of conservation desirable in the short term. While a free market in which all sources of supply compete equally is desirable, it is certainly not in existence today.

Let me identify the conditions we believe are necessary for a free market in energy and suggest steps which need to be taken to remedy present market imperfections and conservation's laggard position. There are six conditions which we believe are essential: an absence of price controls; free competition between different energy sources; a lack of barriers to market entry; neutral government tax and expenditure policies toward different forms of energy; the availability of adequate information to consumers; and, finally, a lack of institutional barriers to inhibit consumers from responding to energy price signals.

The Alliance's analysis of these conditions has produced these major conclusions:

- Despite recent progress in the decontrol of oil prices, gas and electricity prices are still subsidized, retarding conservation of those energy sources.
- Government expenditure and tax policy is not neutral toward all energy sources and currently results in twelve times as much tax expenditures for production as for conservation.
- Competition between potential suppliers of energy, including suppliers of energy efficiency services, is restricted due to the difficulty of market entry and continued regulation.
- The information available to consumers regarding the cost of different energy service options is still inadequate.
- Significant institutional barriers still remain which restrict the ability of prices to signal optimal consumer purchase decisions.

The existence of these conditions limits the ability of all forms of energy, including conservation, to compete on a roughly equal basis. We believe that the stated aim of government energy policy should be to move toward a free market in energy over the next decade, and to initiate step to remedy these market imperfections in the short run.

Specifically, the Alliance staff is recommending that our Board of Directors go on record in supporting two policies which the staff believes will, more than any other, help to ensure energy efficiency's role in national energy policy. The first one is to immediately decontrol the price of both old and new natural gas, and the second is to equalize incentives for conservation with those currently available for other sources of energy, particularly oil and gas. Further, we are proposing that an additional federal tax (what has come to be referred to as a "windfall profits" tax) be placed on "old" gas at the time it is decontrolled. We suggest that the revenues from this tax be used to finance the equalization of incentives for energy efficiency. However, the staff views the tax and the additional incentives as short term strategies to last until about 1988. The last years of the decade should be spent phasing out federal subsidies for all forms of energy production. Under this strategy, we would enter the 90's with a very close approximation of a totally free market in energy in which a range of energy services are marketed to consumers. Also, we believe the Federal government must assist low income persons as they adjust to higher energy costs throughout the 80's. The best type of assistance is to develop programs which deliver permanent energy savings such as building and furnace retrofits.

Speaking to natural gas decontrol first, I would point to the recent history regarding the decontrol of crude oil prices as an indication of the conservation response. When prices are permitted to rise to a fair market rate, cost will greatly influence a consumer's decision to purchase. There is no justification for the Federal government to continue to regulate and subsidize the consumption of natural gas.

The second major policy which the Alliance staff is recommending to our Board of Directors is an equalization of tax and expenditure policies between energy conservation investments and investments in energy production. This policy would both promote an efficient allocation of capital between energy efficiency investments and other fuels, and also help accelerate conservation investments which might otherwise be delayed.

A review of current tax and expenditure policies in the energy markets was recently performed by the Office of Management and Budget and the Joint Committee on Taxation. The conclusions of their analyses point to a substantial imbalance between those expenditures promoting energy supply investments and those promoting energy conservation. In tax incentives alone, the nation in F.Y. 1982 is expected to spend $10,875,000,000 on supply investments -- 12 times the level provided for energy efficiency investments.

Substantial disparities also exist in current direct expenditures for energy supply and conservation investments. As with tax expenditures, a neutral policy based on free market principles would require that federal expenditures be relatively equal between competing energy technolgies, including conservation. The Administration estimates that $1,065,000,000 will be spent in F.Y. 1982 to support energy conservation investments. On the other hand, the government will expend $6,235,000,000 in direct outlays to support various sources of energy supply, a figure which is almost six times the amount spent on conservation. If tax expenditures and direct outlays are added together, the total for F.Y. 1982 for energy conservation is projected to be $1,960,000,000. The comparable total for energy supply is projected at $17,110,000,000[1].

Once again, these are gross figures, but they do provide an indication of the difference between federal support for conservation and energy supply investments. It is sufficient to point out that the present tax expenditure and outlay policy is not neutral either among fuels or between energy supply and energy conservation investments. Because of the lack of neutrality, the policy introduces a bias into the rate of investment for different fuels and energy conservation technologies. This bias is not consistent with free market principles.

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[1] "Special Analysis G: Tax Expenditures," reprint of pp. 203-238 from Special Analyses, Budget of the United States Government, 1982, Office of Management and Budget, January 1981.

What is needed is the development of an energy conservation industry which can effectively compete for capital to invest in the estimated $400 billion worth of cost-effective investments in energy productivity that are waiting to be tapped. To further attract capital, tax incentives should also be extended to third-party investors, including utilities. The term "third-party investor" refers to an individual who makes an investment in plant or equipment at someone else's facility. We believe that capital supplied by third parties can go a long way toward alleviating capital shortage problems.

A review of the current tax credits available for various types of energy efficiency investments shows that the existing residential tax credit is 15% and is limited to the first $2000 of expenditures on energy conservation equipment. Perhaps more significant, the credit is limited to energy conservation expenditures in the taxpayer's "principal residence." This means the credit cannot be taken by landlords for apartment buildings since such buildings are not the "principal residence" of the landlords. In addition, the credit is due to expire on December 31, 1985.

For the commercial building sector the analysis is very simple. There are no special energy conservation tax credits available for efficiency investments in the commercial sector.

For energy efficiency investments in the industrial sector, the situation is somewhat better, but still far from ideal. A limited number of energy efficiency investments are eligible for an additional 10% tax credit. The 10% energy credit for these items is scheduled to end on December 31, 1982, and thus, unless extended, of little future value.

By comparison, the existing credits for oil and gas are quite generous. In a typical oil and gas investment, intangible drilling costs can be written off in the first year, and typically represent 80% of the total amount invested. An oil or gas investor is also allowed the 10% investment tax credit on the remaining tangible drilling costs, as well as straight-line depreciation of the tangible drilling costs over ten years. These incentives are available indefinitely. Taking them all into account, the value to an investor in the 50% bracket is 48¢ on each dollar invested.

By contrast, the tax incentives currently available for energy conservation investments fall substantially short of those available for oil and gas investments. The available energy conservation credits are both smaller as well as much more limited in scope and time.

In summary, the Alliance believes that continued price controls on natural gas and the lack of parity in federal policies regarding tax expenditures for efficiency improvements, vis-a-vis other sources of supply, are in critical need of redress. However, in a lengthy paper which we will make available shortly to this subcommittee, the Alliance also identifies a range of limited government intervention options which would help to overcome other market imperfections identified in this testimony.

Unfortunately, the Administration's National Energy Policy Plan, dated July, 1981, contains no acknowledgement of these market imperfections and, consequently, offers no new conservation initiatives beyond general business and individual tax cuts with which to encourage investment in efficiency improvements. Further, the plan supports withdrawal of the Federal government's financial support from other conservation program areas.

It is the Alliance's view that the government's role is to build a bridge in the 80's toward a free market in energy for the 90's. Because a transition to a free market will take time, government's role in the short term is to equalize disparate incentives between supply sources and conservation. Only by recognizing and addressing current market imperfections will we ensure that conservation's full potential will be recognized in federal energy policy. Additional financial incentives for efficiency improvements are not only compatible with re-industrialization goals, but essential to protect the country from the continued threat of supply disruptions.

Thank you for the opportunity to present these views to the subcommittee. I would welcome the opportunity to discuss them in more detail with Members and appropriate staff.

Ms. Gallagher's Responses to Written Questions Submitted by Senator Percy

Question 1. The Reagan Administration's National Energy Policy Plan asserts that "achieving a low level of U.S. oil imports at any cost is not a major criterion for the nation's energy security and economic health." Could you please comment on this statement and its implications for conservation policy?

Answer. The Alliance would agree with the Administration that achieving a low level of oil imports "at any cost" should not be a major criterion for national security and economic health. We believe, however, that such a statement tends to cloud the issue. Reducing oil imports at a reasonable cost should be a primary objective to promote national security and economic well-being, and the lowest-cost means of reducing imports is through widespread improvements in energy efficiency. We believe the Administration's National Energy Policy Plan and its current tax and budget programs are seriously deficient in recognizing this fact and capitalizing on it. The result almost certainly will be fewer cost-effective investments in energy conservation in the future than would otherwise occur.

Question 2. As I mentioned in my questioning of Mr. Tribble, the National Energy Plan projects net oil imports to be at 6 to 7 million barrels per day in 1985 and 4 to 5 million barrels per day in 1990. Do you agree with these projections? Do you think we would be doing well as a nation if we were still importing that much oil in those years?

Answer. The National Energy Policy Plan's estimates of 1985 and 1990 net oil imports, as with any estimates, are based upon certain projections of emonomic, legal, social and other conditions in the target years. It is difficult to determine whether the Administration's projections will be correct, and thus whether the 1985 and 1990 estimates will prove accurate. What is not difficult to determine, however, is whether the Administration's current policies, if adopted throughout the 1980's, would result in more oil imports than would occur with greater Federal support for energy conservation. Undoubtedly, the Administration's policies would have this effect. In this sense, the level of oil imports estimated by the Administration for 1985 and 1990 would be unacceptably high. If those import levels do come to pass, the United States will have ignored many cost-effective opportunities to save energy and reduce its oil imports. As a nation, it will not be doing as well as it might otherwise.

Question 3. The National Energy Policy Plan indicates that there will be a need to increase the electrical generating capacity of power plants, while making no mention of the alternative of investing in cogeneration, load-leveling, or other conservation technologies in the utility sector. Will each of you please comment on the degree to which conservation could offset the need for new generating capacity and outline for us which conservation measures you find most promising?

Answer. Under a grant from the John A. Hartford Foundation, the Alliance has underway a study with the Arkansas Power & Light Company ("AP&L") which addresses the question of how great a role conservation can play in reducing the need for new electric generating capacity. Specific conservation opportunities are being identified and analyzed by Alliance and AP&L engineers. Subsequent analyses of these opportunities will determine whether conservation investments would, through a reduction in consumer demand for electricity, "back out" more oil and result in better financial health for the utility than would taking the same amount of capital and converting two of AP&L's oil-fired units to coal.

While this study is not far enough along to provide a definitive response to these questions, either in the context of AP&L's system or more generally, the Alliance believes that conservation can and should play a considerable role in offsetting the need for new generating capacity. Extensive utility investments in conservation almost certainly will not avoid all need for new generating capacity in the future—indeed, some conservation opportunities such as cogeneration will entail new generating capacity—but they are likely to reduce that need considerably and to improve overall generating efficiency in the process. The most cost-effective investments will vary from system to system, but in general we believe that cogeneration units and a variety of plant or system retrofits often will be among the most effective.

Question 4. The responsibility for the Administration's low-income energy assistance and weatherization programs has been shifted from the Energy Department to the Department of Health and Human Services—an agency with little conservation expertise. How well do you feel these agencies will administer these programs? Are you concerned about this?

Answer. As reflected in Alliance comments to appropriate committees of Congress earlier this year, the transfer of the low-income weatherization program from the Department of Energy to the Department of Housing and Urban Development would be a major mistake. The weatherization program would be folded into a reduced Community Development Block Grant program, where it would have to compete for funding with other, established uses of CDBG moneys. The result, we believe, would be a sharp cut in Federal assistance for weatherization.

Fortunately, this result has not come to pass in the reconciliation process just completed by Congress. The Alliance likely would oppose any such transfer in the future, and we believe that the task now at hand is for DOE, through its re-authorized weatherization program, and the Department of Health and Human Services, through its new community services block grants and the newly-authorized weatherization component of its fuel assistance program, to provide as much weatherization assistance as possible to eligible recipients.

Under a grant from the Ford Foundation, the Alliance will be working with Federal, State and local officials to promote the use of fuel assistance moneys for weatherization and to suggest ways to better coordinate all weatherization efforts. With more extensive weatherization, meaningful lon-term reductions in fuel consumption can be achieved, and the condition of both individual energy consumers and the Nation can be measurably and permanently improved.

Question 5. Under the proposed budget cuts for fiscal year 1982, the DOE budget conservation will be reduced by 63 percent. Personnel in the Office of Conservation is scheduled to reduce its staff by almost one-third by this September. In addition, major changes are occurring in several DOE conservation programs. Would you please comment on the effect that these budget and program changes might have on DOE's conservation efforts in the future?

Answer. While the Administration's proposed budget cuts for DOE conservation programs were only partially adopted by Congress, the cutbacks that were made likely will have a serious adverse effect on several DOE programs which have proved themselves cost-effective. Included among these are the industrial energy conservation program, various programs under buildings and community systems, and state energy programs. While we believe that Congress was correct in not terminating these and other conservation programs, we believe they should be restored to previous funding levels. Indeed, such a restoration of funds is all the more justified because of the unequal treatment which conservation received when compared to nuclear or even fossil fuels. The Alliance will work to achieve more equal treatment in the future.

Question 6. In my view, we have to look beyond line-item budgets and programs to see what is really happening. President Reagan's decision to decontrol the price of oil indicates to me that this Administration is basically pro-conservation. How would you rate the effect of this decontrol action on conservation compared to the effect of the regulatory and other measures that were imposed by previous administrations?

Answer. The decontrol of oil undoubtedly will have a major effect in promoting energy conservation. Decontrol alone, however, is not sufficient to achieve an optimal amount of conservation as quickly as possible. While we oppose unnecessary interventions into a free energy market, we believe that certain distortions in that market call for carefully selected corrective measures that promote conservation. A foremost example is found with appliance efficiency standards. Such standards are needed for certain products such as furnaces, washing machines and dryers, and refrigerators because the ultimate users frequently do not purchase them in a free market. Rather, users often purchase these appliances from a contractor as part of a new or renovated home. Contractors, however, frequently wish to minimize the purchase price of such items regardless of their energy efficiency; thus they do not base their purchases on life-cycle costs and possibly other factors more appropriate in traditional free market decisions. Appliance

efficiency standards and a limited number of other market intervention strategies are therefore appropriate in supplementing price decontrol to achieve the amount of energy conservation which a truly free market would provide.

***Question* 7. One of the most difficult and controversial decisions that this Administration will face regarding energy will be whether to accelerate the deregulation of natural gas. Plainly, one of the benefits of accelerated decontrol will be to stimulate investment in conservation, but we must acknowledge that the rapid deregulation of natural gas could raise prices for gas customers in Illinois and other states. Could you briefly give me your views on natural gas decontrol and the advisability of accelerating deregulation in this area?**

Answer. As we discussed briefly in our oral comments and at more length in our written statement, the staff of the Alliance is recommending to our Board of Directors that they formally endorse the deregulation of old and new natural gas in 1982, provided that a windfall tax is imposed on old gas. The revenues from such a tax should be used to fund energy conservation programs and credits and to provide assistance to low-income households in meeting the increased costs which decontrol of natural gas would bring about. While fully recognizing the short-term impact that higher prices may have in certain instances, we believe that decontrol is necessary and desirable to encourage much-needed investments in additional energy conservation. We favor methods other than price controls to address any hardships or inequities which decontrol may bring about.

An Energy Conservation Strategy for the 1980's

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Testimony
before the
Subcommittee on Energy, Nuclear Proliferation, and Government Processes
of the
Senate Committee on Governmental Affairs

July 21, 1981

Table of Contents

	Page
The Potential for Fuel Conservation	2
The Impacts of Rising Prices	4
Why the Invisible Hand is Moving So Slowly	6
What Kind of Policy is Needed?	7
Elements of a Market-Oriented Fuel Conservation Policy	12
Rationalizing the Pricing of Energy	12
Improving the Flow of Information	15
Fostering the Creation of an Industry that Sells "Saved Energy"	17
Protecting the Poor Against the Burden of High Energy Costs	21
Supporting Research on Energy Efficiency	22

In my testimony I intend to sketch in general terms the elements of a market-oriented energy conservation strategy. My remarks essentially summarize the conclusions and recommendations of a book which I have coauthored and which was published earlier this year (Marc H. Ross and Robert H. Williams, Our Energy: Regaining Control, McGraw-Hill, 1981), describing an energy conserving future for the United States.

My label "market-oriented" strategy does not refer to that will-of-the-wisp, the absolutely free market described by Adam Smith:

> "[Every businessman] neither intends to promote the public interest nor knows how much he is promoting it... he intends only his own security,...he intends only his own gain, and he is in this...led by an invisible hand to promote an end which was no part of his intention...By promoting his own interest he frequently promotes that of society more effectively than when he really intends to promote it."

Instead I am talking about fostering the creation of a market that is "free" on a fine scale, in the sense that transactions between individual consumers and producers would not be encumbered by the heavy hand of public policy administered via price controls, allocation rules, and the like. Rather, such transactions would be guided by a public policy in which the major emphasis would be on regulating the market on a broad scale, via measures aimed at fostering competitive conditions for providing energy services and at creating an economic climate in which consumer decisions would take into account the total costs of these services -- including social costs not normally reflected in market prices.

The major public policy initiatives associated with this market strategy involve deemphasizing economic regulations, eliminating energy supply subsidies, levying energy taxes that are rebated or substituted for certain existing taxes, improving the flow of information, encouraging the development of an industry to market "saved energy," protecting the poor from the impact of high energy costs, and supporting research. All of these measures should be carried out in concert if there is to be a truly effective market-oriented policy for energy conservation.

I shall restrict my comments on energy conservation to opportunities for preserving or enhancing amenity through the more efficient utilization of energy resources which would result from minimizing lifecycle costs. Thus my remarks refer to saving home heating fuel by reducing heat losses and making furnaces more energy efficient - not by turning back thermostats in winter; to saving automotive fuel by spurring the shift to cars with higher fuel economy - not by restricting mobility; to saving industrial fuel by adopting more energy efficient processes - not by curtailing production.

The Potential for Fuel Conservation

In our book, Ross and I show that if energy conserving investments and energy supply investments are given an evenhanded treatment in market decisions relating to energy, the resulting fuel savings would be far greater than most other analyses have indicated. We estimate energy demand could actually be reduced some 15% below the present level over the next 30 years, despite a doubling of GNP.

The realization of this potential would make our energy supply problem far more manageable; it would lead to great environmental benefits because it would be possible to avoid the most risky technologies; and it would generate substantial economic benefits, because for a long time to come it will be far cheaper to save a Btu through energy efficiency investments than to produce an extra Btu of energy supply.

The economic benefits of conservation can be illustrated by the concept of the "cost of saved energy." Suppose that a homeowner secures a home improvement loan to reduce the heat leaks from his house. The cost of saved energy is obtained by imagining that the term of the loan is the same as the expected life of the investment. Then the cost of saved energy is:

$$\frac{\text{the annual loan payment (principal + interest)}}{\text{annual energy savings}}$$

Some examples:

- For the "Bowman house" in Maryland, retrofitted by the National Bureau of Standards, an investment of $2840 in 1978 ($3380 in 1980 $) resulted in an annual oil savings of 580 gallons (a 59% reduction), corresponding to a cost of saved energy of $0.60 a gallon (1980 $).[1] For comparison the average heating oil price in 1980 was $0.98 a gallon.

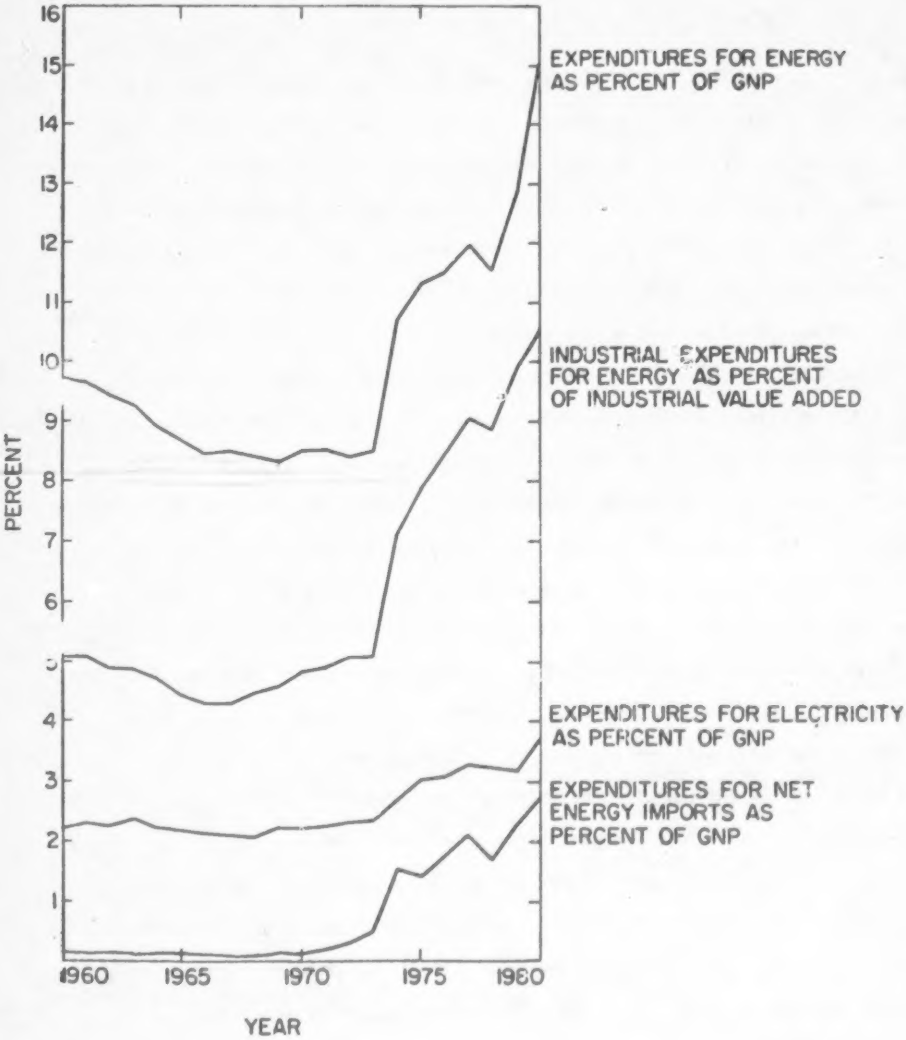
- An NBS program involving both CSA/CETA and private contractor retrofits of 20 homes in Portland, Maine led to an average oil savings of 612 gallons (a 38% reduction) for an average investment of $2380 per home, corresponding to an average cost of saved energy of $0.40 a gallon.[2]

- For a new 2000 ft^2 home in an average U.S. climate, an additional investment of $2000 to improve the building shell beyond the current construction practice so as to conform to the proposed BEPS standards would save 215 gallons of oil equivalent per year (a 38% reduction), for an average cost of saved energy of about $0.62 per gallon.[3]
- More than a 50% reduction in electricity requirements for frost free refrigerators could be achieved with modest design improvements that would add about $100 to the purchase price of the refrigerator. The cost of saved energy for this investment would be about 1.6c/kwh, which is only about 1/3 the residential electricity price in mid 1980.[4]
- On the basis of evidence documented in the technical literature relating to automotive fuel economy it has been shown that the average on-the-road fuel economy of new cars* could be raised by 1995 to 50-60 mpg for a cost of saved gasoline less than $1.00 per gallon.[5]

The Impacts of Rising Prices

In light of such attractive economics, one would expect a frenzied rush to conservation. And indeed there has been significant progress in the U.S. economy toward realization of the conservation potential. In 1980 11% less energy was required to produce a dollar of GNP than in 1973. However, to date the rate of development of the energy crisis has far outstripped the rate of the conservation response. Figure 1 shows that after the first oil shock of 1973 there has been a dramatic continuing shift of economic resources to energy expenditures from other productive activities. Retail expenditures on energy in

Figure 1


16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
PERCENT
1960
1965
1970
1975
1980
YEAR
EXPENDITURES FOR ENERGY AS PERCENT OF GNP
INDUSTRIAL EXPENDITURES FOR ENERGY AS PERCENT OF INDUSTRIAL VALUE ADDED
EXPENDITURES FOR ELECTRICITY AS PERCENT OF GNP
EXPENDITURES FOR NET ENERGY IMPORTS AS PERCENT OF GNP

the U.S. increased from 8 1/2 to 12% of GNP between 1973 and 1977, and, with the second oil shock, this percentage increased further to 15% in 1980.

The industrial sector has been especially hard hit. Industrial expenditures on energy, expressed as a percentage of industrial value added, increased from 5% to 10 1/2% between 1973 and 1980. And these aggregate industrial figures do not reveal the very serious impacts of the energy crisis on the most energy intensive materials processing industries.

Consider the aluminum industry. Purchased electricity accounted for 12% of the price of primary aluminum in 1971, despite the fact that electricity cost only 0.8¢/kwh (in 1980 $) in that year - considerably less than the 1.9¢/kwh (in 1980 $) paid then on the average by all industries. By 1978 the price of electricity to the aluminum industry had increased 70% (in constant dollars). This electricity price increase was a major factor behind the 20% increase in the real price of primary aluminum between 1973 and 1978.

The energy intensive industries can be expected to be hit even harder in the future. Again consider the aluminum industry. As shown in Figure 2 the price this industry paid for electricity in 1978 was still less than 1/2 the average price paid by all industries and was only 1/5 to 1/4 the cost of electricity delivered to industry from a new coal-fired power plant (see Figure 2). At the level of the electricity requirements for the newest aluminum smelters (6 1/2 kwh per pound) and the replacement cost of electricity, electricity costs would be equivalent to 50-60% of the 1980 primary aluminum price! Thus as more power plants are built, thereby driving up the electricity price toward the replacement cost, there would be powerful upward pressure on the price of aluminum.

Low income households are also being especially hard hit by rising energy prices. Consider the 11 million households with incomes below $5000 in 1977. I estimate that

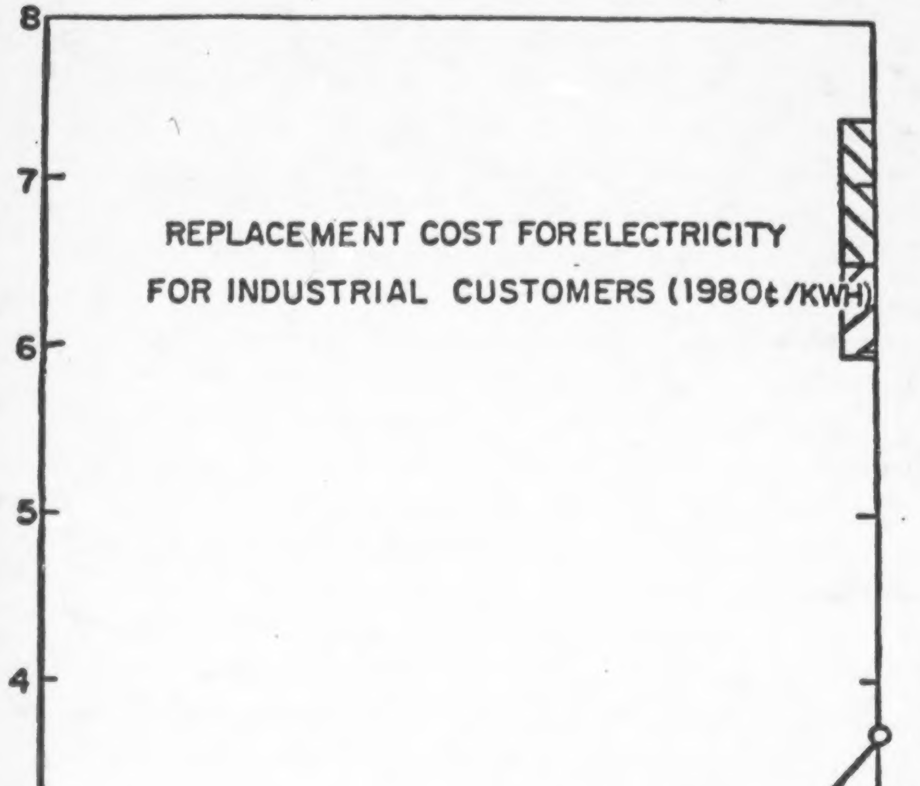

REPLACEMENT COST FOR ELECTRICITY FOR INDUSTRIAL CUSTOMERS (1980¢/KWH)
AVERAGE INDUSTRIAL ELECTRICITY PRICE (1980 ¢/kwh)
PRICE OF ELECTRICITY TO ALUMINUM PRODUCERS (1980 ¢/kwh)
0
1
2
3
4
5
6
7
8
1970
1972
1974
1976
1978
1980

Figure 2

these households spent $11 billion dollars in 1980 or about 28% of their income on household fuel, electricity, and gasoline, compared to less than 10% for households with the average 1977 income level of $16,100.[6]

Why the Invisible Hand Is Moving So Slowly

Given the doubling of the average real energy price in the U.S. economy between 1973 and 1980 (a 2 1/2-fold increase in the average real price of industrial energy) and the enormous opportunities to save energy at costs far below present energy prices, the 11% reduction in the energy intensity of the U.S. economy over the last 7 years seems quite modest. Why has progress been so slow?

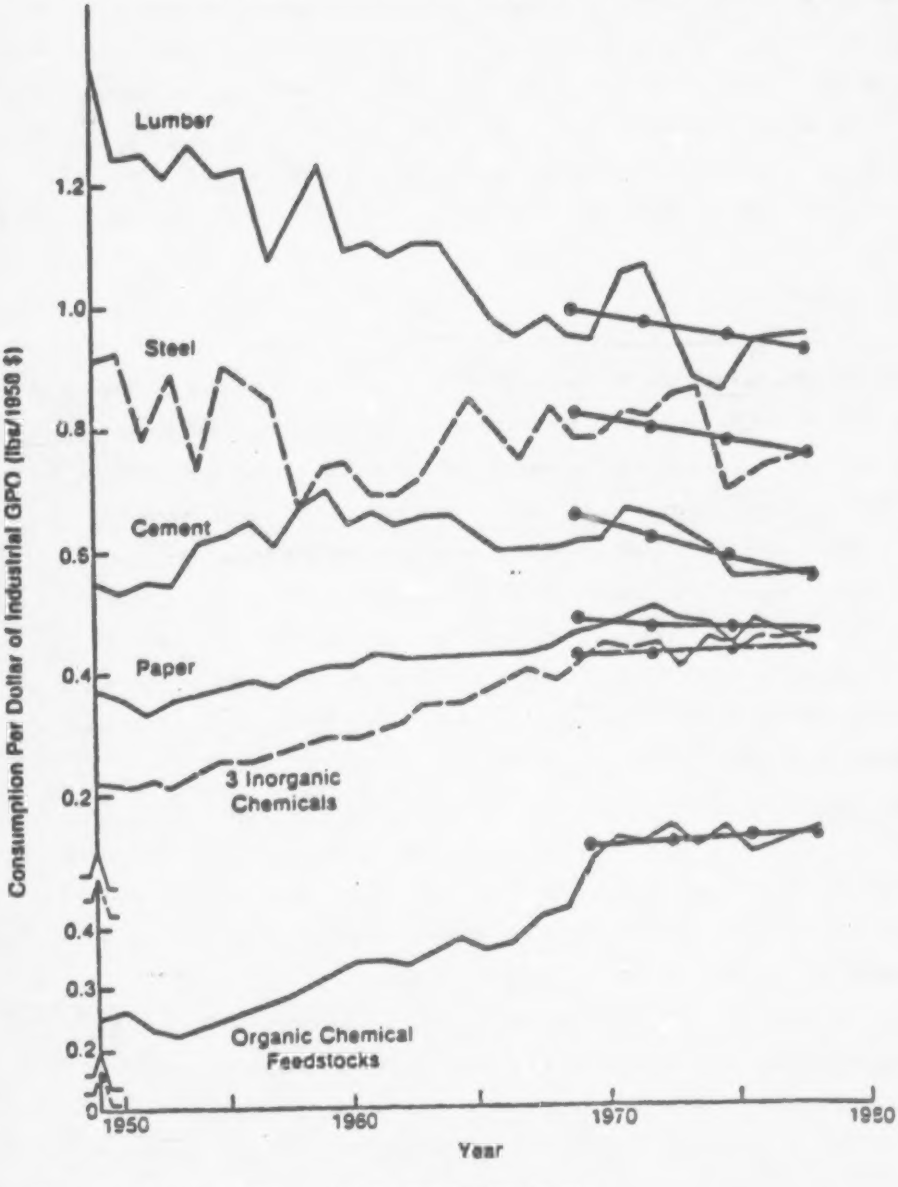
Particularly sensitive groups of course pose special problems. Low income families are not making cost-justified investments on the order of $2000 to $3000 per household simply because they are poor.

The energy intensive basic materials processing industries, which account for 70% of all industrial energy use and more than 25% of all energy use, also face a capital shortage. The physical plant in these industries has been antiquated by rapidly rising energy prices. Much of this industrial plant needs to be scrapped and rebuilt. Yet these industries have been unable to respond adequately to changing price signals. Many companies in these industries have such high debt-equity ratios that conventional borrowing is no longer feasible. Moreover, slow growth in demand for the products of these industries has meant shrinking profits and diminished ability to finance projects with internal funds.

The sluggish growth of US basic materials processing industries appears to be associated with a fundamental shift that is taking place in our economy. As shown in Figure 3, growth in these industries has slowed down in relation to growth in total industrial value added. The decline in materials intensity of our industrial economy is manifest in the phenomenon that the goods consumers

FIGURE 3

Consumption of Basic Materials by Industry, 1950 - 1978



SOURCE: M. Ross and R. Williams. Our Energy/Regaining Control buy are containing more "value added" and less raw materials. This phenomenon has been due in part to rising energy and raw materials prices; but also it has been due to saturation effects. We should not be surprised by this. We have such a materials intensive society that on a per capita basis we consume our own weight in "stuff" each day - see Figure 4.

While the slowdown in demand growth for basic materials means that future demand for energy by these industries will be much less than most energy forecasters have recognized, this slowdown makes modernization of these industries difficult.

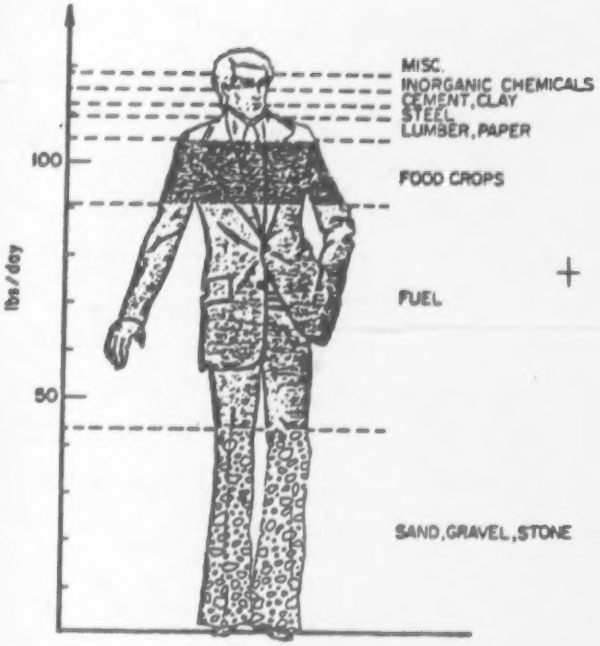
Aside from the special problems posed by low income households and the energy intensive basic materials processing industries, there are also more fundamental reasons why our economy is not exploiting more rapidly the potential for energy conservation. In a nutshell, because of its historical focus on energy supply, our present economic system provides inadequate motivation, inadequate information, inadequate organization, and inadequate preparation for the longer term (i.e., inadequate support for research), to permit an even-handed treatment of energy supply and energy efficiency investments. In effect the "invisible hand" of the free market has been slowed by numerous institutional obstacles. A strong federal role is needed to overcome these obstacles to cost-effective intestments in energy efficiency.

What Kind of Policy is Needed?

One way to deal with these institutional obstacles is to adopt policies that force the adoption of the technologies that are being treated unfairly. Indeed the most familiar kinds of energy conservation policy instruments are of this type -- regulations of energy performance and targeted incentives.

. The automotive fuel economy standards mandated by Congress in 1975 is an example of a successful regulatory initiative to promote energy conservation. One reason for the success of this policy is that automotive passenger transport is

FIGURE 4



PER CAPITA CONSUMPTION OF BASIC MATERIALS IN THE U.S.

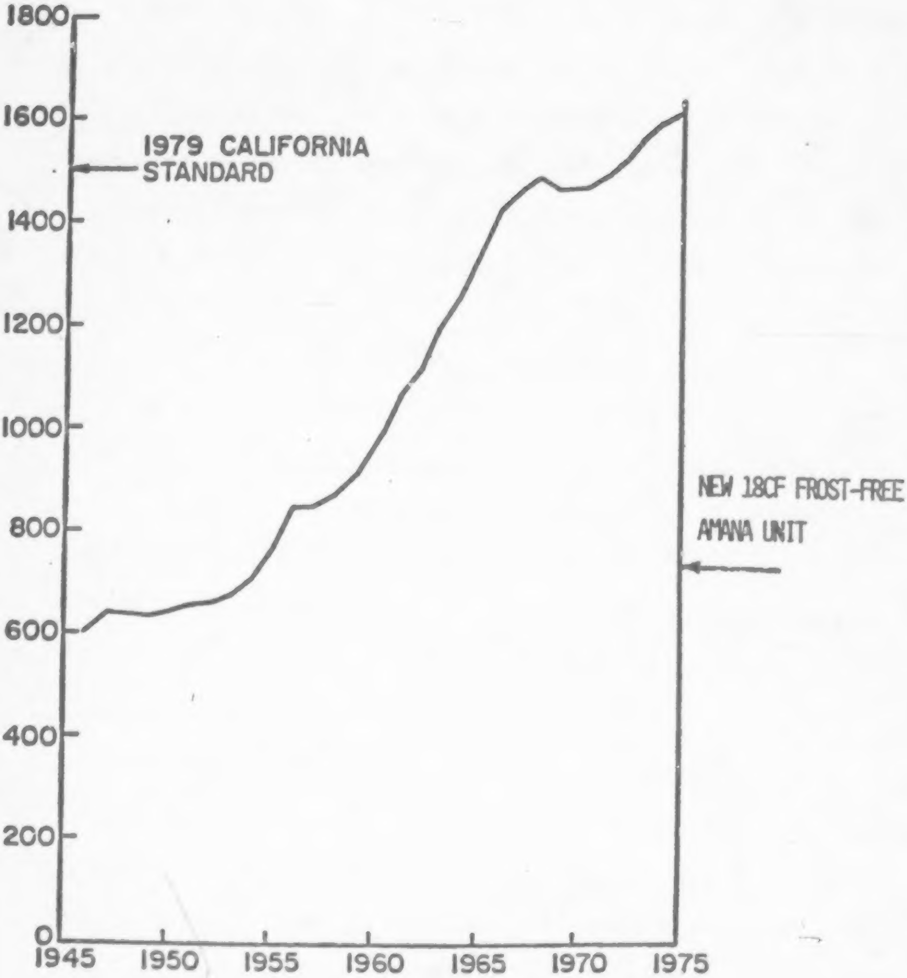
Source: M.H. Ross and R.H. Williams, Our Energy: Regaining Control a universal activity characterized by a familiar, readily measurable energy performance index - the miles per gallon rating. Fuel economy standards can be implemented with relative ease, and they are readily understood by consumers. Moreover, it is clear that the domestic automotive industry is much better off today than it would have been had the fuel economy standards not been imposed. The drop in domestic auto sales following the gasoline price shock of 1979 would have been far worse had Detroit not been required to begin retooling to produce the more fuel efficient cars consumers are now demanding.

Targeted incentives, such as energy conservation investment tax credits, are also quite popular. Such incentives, which are aimed at overcoming institutional barriers to energy conservation by rewarding those who make investments in energy efficiency, have the attraction of being a carrot rather than a stick.

Despite the attractions of regulations of energy performance and targeted incentives, however, these approaches have a number of major limits as policy instruments:

- Regulations of energy performance are often weak stimuli for technological change, because of the tendency to set standards at levels far from the "technological frontier" in energy efficiency. Figure 5 illustrates this point for refrigerators, showing that the 1979 California standard is near the performance of the average refrigerator being sold, while the best refrigerator on the market has better than double the average efficiency.

FIGURE 5



ELECTRICITY REQUIREMENTS FOR REFRIGERATOR
(KwH PER YEAR)

- A regulation of energy performance forces technological change to meet the performance test required in the regulation, which may differ from the performance index in the "real world." Consumers are generally familiar, for example, with the phenomenon that the labeled fuel economy for new cars (determined in EPA testing procedures) is better than the actual on-the-road fuel economy.

- Regulations of energy performance and targeted incentives work best when applied to universal technologies (such as automobiles and certain energy intensive appliances like refrigerators), for which an energy performance index is relatively well defined, measurable, and readily understood. But a large fraction of total energy use cannot be so characterized.

- Targeted incentives cannot be readily applied to measures that serve multiple functions, which often represent better investments than measures designed for one purpose only. This can be illustrated by a comparison of active and passive solar heating technologies. Federal incentives are targeted at active systems (involving rooftop collectors), which have the single function of providing heat. Because passive collectors are south-facing windows that serve a dual function, they do not qualify for an incentive. Nor should they! Why should the government subsidize the installation of a fancy window system? Yet passive systems are usually more cost effective than active systems.

- Targeted incentives tend to stifle innovation, simply because a measure must be well-defined to qualify for a targeted incentive. But some of the most exciting technical innovations are not well defined, simply because they are especially innovative. Consider energy use associated with the drying of paint on, say, beer cans. One way to save energy here is to put a heat recuperator on the paint-drying oven. A tax incentive could be defined for encouraging the installation of such recuperators. However, the use of paints "tuned" to dry on exposure to ultraviolet light of a specific wavelength would lead to much greater energy savings. Yet the use of "tuned paints" would not qualify for such an incentive.

- There are sometimes unintended side effects of targeted incentives. For example, one of the consequences of TVA's program of offering interest-free loans to homeowners for making conservation investments, is that between 1975 and 1979 the percentage of new homes without attic insulation in the TVA area increased from 4.5 to 17.1%.[8] Apparently builders reasoned that it wasn't necessary to install the attic insulation, because homeowners could install it later with the benefit of an interest-free loan.

- And finally, targeted incentives are often economically inefficient. First, tax subsidies are quite costly. The present tax subsidies for energy conservation investments, though less than 10% of the tax subsidies for energy supply investments, are greater, in terms of federal budget outlay equivalents, than the budget outlays for all other federal energy conservation programs combined.[9] The question arises whether such large expenditures represent the best use of limited federal resources. And second, targeted incentives sometimes lead to investments that are far from optimal. For example, the residential tax credits (15% for conservation, with a maximum of $300, and 40% for solar, with a maximum of $4000) have the effect of favoring solar over conservation investments, even though the annual fuel savings per dollar invested is usually far greater for conservation than for solar investments.

Because of these problems with regulating energy performance and targeted incentives, it is desirable to try to identify more broadly gauged alternative public policy initiatives, aimed at creating an economic climate conducive to investments in energy efficiency which are cost effective. This means that policies aimed at removing market imperfections are to be preferred to policies designed to compensate for market imperfections. I do not mean to imply that regulations of energy performance and targeted incentives should not be used, but I feel such measures should be used sparingly. I suggest that they be restricted by the following conditions:

- They should be used primarily for: well defined universal energy consuming activities (e.g., for automobiles and certain energy intensive household appliances), so that the policy can be formulated in terms of a meaningful energy performance index; and for "sticky" problems where alternative market-oriented policies are not likely to be effective (e.g., where one seeks to improve the energy efficiency of space conditioning in rental housing).

- The policies should be designed to be phased out as market conditions improve to the point where investments in energy supply and energy efficiency are treated in an even-handed way.

Elements of a Market-Oriented Fuel Conservation Policy

To bring about an even-handed treatment of energy supply and energy efficiency investments in our economy, new public policy initiatives are needed to:

- rationalize the pricing of energy
- improve the flow of information
- foster the creation of an industry that sells "saved energy"
- protect the poor against the burden of high energy costs
- support research on energy efficiency

Rationalizing the pricing of energy: Even with oil and gas price decontrol energy prices would still not reflect the full social costs of producing and consuming new energy supplies. While the idea of still higher prices is painful, the plain truth is that artificially low prices are a powerful deterrent to conservation investments. Instead of holding prices down we should be phasing in prices that reflect full social costs, while simultaneously protecting low income households from the burden of higher fuel bills by enabling them to make energy efficiency investments (see below).

Besides oil and gas price deregulation we should be seriously considering moving toward the deregulation of electricity generation as well. Replacement costs for electricity in most areas are far in excess of present prices (see Figure 2), and the resulting artificially low electricity prices are creating a demand for new plants in excess of what would be required with prices based on true costs.

At the same time the fundamental rationale for economic regulation of power generation is breaking down. Recent developments mean that power generation no longer represents a natural monopoly. There no longer appear to be economies of scale to be captured by building generating plants larger; in fact, there is substantial evidence that the point of diminishing returns to increasing scale may already have been exceeded with the largest plants. Moreover, cogeneration plants, under a wide range of circumstances, can provide electricity competitively with central station plants 10, 100 and sometimes 1000 times as large.[10] And finally, modern transmission technology has made it possible to serve any particular need for power via generation facilities dispersed over a wide region.

It is natural therefore to propose that serious consideration be given to separating the power-generation business from transmission and distribution and allowing the power generation industry to become competitive.* So doing would help limit electricity price increases in the new era of rising marginal costs and uncertain future demand.

Significant market distortions also arise from subsidies provided to the energy supply industries. The federal budget outlay equivalent of the tax subsidies in support of the routine provision of energy have been estimated to be about $10 billion for fiscal year 1981.[9] These subsidies along with price controls, have contributed to the established trend toward overinvestment in energy supply. The percentage of all new plant and equipment expenditures in the U.S. economy going to energy supply rose from an average of less than 25% in the 1960's to over 40% in the later 1970's (see Figure 6).

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* The organization of electricity transmission and distribution activities might be modified as well. One possibility would be to establish a regionally based natural monopoly for transmission, regulated at the federal level, with community-scale distribution companies regulated at the state level.

This overinvestment in energy supply helps create a general scarcity of capital resources for energy efficiency investments. It comes at a time when it is essential to speed up the overall rate of capital investment, to replace outmoded existing energy-using capital equipment designed for the era of cheap energy and to help reestablish the position of American indsutry in world markets.

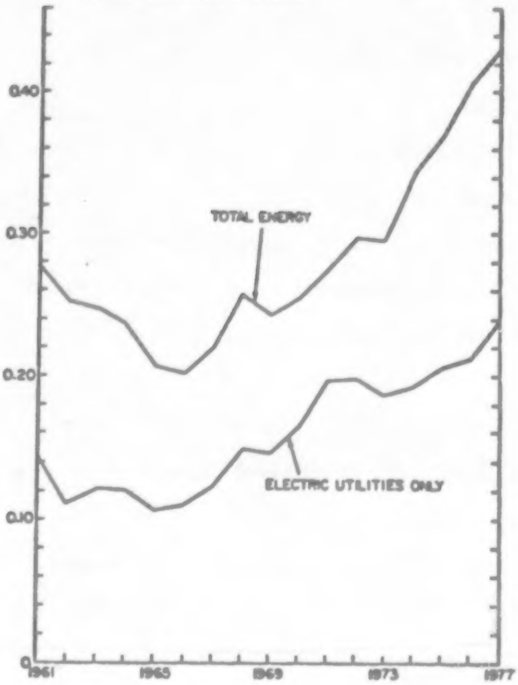
Because existing tax subsidies grossly bias investments in favor of energy supply it is desirable to abolish all targeted incentives for both the routine provision of energy and also for the commerical demonstration of new tehnologies, and to formulate instead measures to improve the general investment climate.

In this effort particular attention should be given to the basic materials processing industries, which represent the backbone of our industrial economy and account for over 70% of total industrial energy use. Policies intended to improve the general investment climate should be designed to encourage substantial rebuilding in these industries.

Policies to decontrol energy prices and to eliminate targeted subsidies by themselves would not lead to prices that reflect the full social costs of energy production and use, because there are social costs that are not included in market prices - e.g., the national security cost associated with our dependence on insecure sources of foreign oil and environmental impacts associated with energy production and use. These could be accounted for by introducing energy taxes that are rebated or used to offset certain existing taxes, as part of a general tax reform effort. In my view the most serious

FIGURE 6

FRACTION OF NEW PLANT AND EQUIPMENT EXPENDITURES COMMITTED TO ENERGY SUPPLY



Source: M. Ross and R. Williams, Our Energy/Regaining Control

Capital expenditures in energy producing industries were obtained from Table 7.1, p. 128, in the Energy Information Administration's Annual Report to Congress, vol. 3, 1978. Excluded are expenditures for pipelines, tankers, chemical plants, marketing, and other "downstream" capital expenditures. Total new plant and equipment expenditures for the U.S. are obtained from "Economic Indicators," prepared for the Joint Economic Committee by the Council of Economic Advisors, various issues.

Since this figure was prepared the term "new plant and equipment expenditures" has been redefined by the Bureau of Economic Analysis of the Department of Commerce. The definition now includes all non-farm business. The most significant change is the inclusion of four new sectors: real estate; professional services; social services and membership organizations; and forestry, fisheries, and agricultural services. The new plant and equipment expenditures for these sectors involve enormous capital expenditures for the construction of commercial buildings. With the new definition the energy supply sector's share of total new plant and expenditures was 29.4% in 1977; however, the energy supply sector's share of total new plant and expenditures by manufacturing, mining, and public utilities with the new definition was 55.4% in 1977!

of the various "external social costs" at the present time is the national security risk associated with a high level of oil imports. Thus some kind of tax on petroleum or petroleum products is especially important - perhaps a tariff on petroleum imports. There are many possibilities for the compensating tax reduction. Some examples are: direct rebates to adults; and the use of the tax revenues to offset corporate income taxes (to help create a more favorable investment climate) and social security taxes (a particularly regressive tax).

Improving the flow of information: Even when energy consumers are adequately motivated to save energy, they often do not have adequate access to information on which to base decisions. One aspect of this problem is that known information is not readily available to various decision-makers. Most homeowners still do not have good information as to the most cost-effective investments that they can make in saving energy in their homes; and when they are shopping for a new home they usually do not have available to them adequate information concerning the relative energy efficiencies of the houses that they are inspecting. Even in industry energy managers are often not familiar with known opportunities for energy efficiency improvements which go far beyond traditional "leak plugging".

One of the most important initiatives that could be taken to improve the flow of information is the mandatory labeling of the energy performance of various consumer products relating to energy intensive activities. In the automotive area the labeling of the fuel economy implications of various engine and transmission oils* and tires** would be desirable. In buildings labeling should be required both for major energy consuming appliances and for the space conditioning fuel requirements. (Note: a labeling requirement is not the same as a performance standard.) In the case of buildings (both new and "used") labeling based on a diagnostic measurement (not simply computer simulation) at the time of sale should be the eventual objective of public policy. R&D in support of developing a quick and meaningful diagnostic measure is needed.

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* It has been estimated that the overall potential for fuel economy improvements from putting synthetic oils with antifriction additives into both engines and transmissions may be as high as 12% by 1985,[11] giving rise to a potential 1985 oil savings of some 0.5 million barrels per day.

** G.M.'s expectation is that ultimately the average tire's rolling resistance can be reduced by 33-50 percent relative to its 1979 value,[12] corresponding roughly to a 10-15 percent improvement in automotive fuel economy and an additional oil savings comparable to that achievable with improved synthetic oils.

A second informational problem is that in many instances an adequate information base for determining targets of opportunity for saving energy is not even available to the experts. Our energy consumption data base is often too highly aggregated to be able to do more than guess what the best conservation investments might be. In industrial plants, for example, the energy consumption data available to plant managers is usually not disaggregated to the level of the processes for which the investments should be made but instead is aggregated at the plant level, which involves energy use for many different activities. The data base for energy use by activity is also relatively poor in buildings.

Because of the importance of this information for a market-oriented approach to conservation and the relatively low cost of the required data acquisition and analysis efforts, support for the collection and analysis of disaggregated energy demand data should be increased.

Still another "information gap" arises because we know only vaguely how effective various conservation measures are. Projected savings, based on theory, are often inadequate because real world houses and vehicles and factories don't behave as predicted by theoretical models. Because of this problem the government should give high priority to "score-keeping" programs to measure and evaluate the impacts of ongoing conservation efforts. These programs should involve monitoring not just energy performance but also potential side effects of conservation measures. Some examples: moisture buildup and rot in walls and ceilings associated with improper installation of insulation, the fire hazard potential of various conservation measures, and the buildup of indoor air pollution associated with measures to reduce air infiltration, and the safety of small cars. These score-keeping programs would provide both consumers and decision-makers feedback and thereby enable continuing improvement in the energy conserving efforts.

Fostering the creation of an industry that sells "saved energy": Even with "rational energy prices" and "perfect information" conservation investments would be inhibited, because there is no well-established industrial infrastructure for providing energy conservation services that would enable consumers to minimize "life cycle" costs at the new higher levels of energy prices. The government could help foster the development of a new industry that markets "saved energy" in a number of ways. Some examples:

- Electric and gas utilities, having both better access to capital resources than most firms and an established relationship with their many customers in need of investments in "saved energy", are often in a good position to market "saved energy" as well as electricity and gas. Present regulations that inhibit such activities should be reexamined.

  It has been shown, for example, that utility ownership of cogeneration facilities at industrial sites may be necessary to promote cogeneration to the status of a major fuel saving technology for the nation,[10] because the technologies that give rise to the greatest fuel savings, often involve the production of 2-10 times as much electricity as is needed onsite,* and industrial managers who want to cogenerate are usually interested in meeting mainly onsite electrical needs.

Yet the benefits to qualifying cogenerators provided by Section 210 of the Public Utility Regulatory Policy Act (PURPA) of 1978 are not available with full utility ownership of cogeneration facilities. Amending the PURPA legislation to make the benefits neutral with regard to ownership would probably greatly facilitate the exploitation of the potential for cogeneration.

- A powerful strategy for shifting the household appliance market to the "technological frontier" in appliance energy efficiency would involve utilities making rebates for purchases of new appliances that are more efficient than the average new appliances being sold. Utilities could spend in rebates some of the savings which they would realize as a result of not having to make costly fuel purchases or building costly new power plants.[14] Utilities should be encouraged to offer such programs.

- A similar strategy could be pursued to promote the development and marketing of fuel efficient cars by Detroit. It is possible and cost-effective with currently available automotive technology to

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* See, for example, Table 1 which shows an estimate of the economic cogeneration potential in southern Arkansas, prepared by Wieble Alley of Arkansas Power and Light, a utility contemplating a large scale utility-owned cogeneration effort.[13] With the high fuel saving technology contemplated by AP&L and utility ownership, the installed cogeneration capacity in the region would be about 4 times the capacity associated with present electricity use by these steam using firms. Note that the cogeneration potential in this relatively small region is equivalent to the capacity of 2 large coal or nuclear central station power plants.

TABLE 1a

PROSPECTIVE CUSTOMERS FOR AP&L-PRODUCED COGENERATED ENERGY
(As of 1/26/81)

	CUSTOMER	LOCATION
1	Alcoa	Benton, Arkansas
2	Anthony Timberlands, Inc.	Bearden, Arkansas
3	Arkansas Chemicals Inc.	El Dorado, Arkansas
4	Bear Brand Roofing, Inc.	Bearden, Arkansas
5	Berry Petroleum Company	Stephens, Arkansas
6	Burlington Industries	Monticello, Arkansas
7	Calion Lumber Company, Inc.	Calion, Arkansas
8	Cooper Industrial Products	El Dorado, Arkansas
9	Country Pride Food Limited (Inc.)	El Dorado, Arkansas
10	Cross Oil & Refinery Co. of Arkansas	Smackover, Arkansas
11	Deltic Farm & Timber Company, Inc.	Waldo, Arkansas
12	The Dow Chemical Company (Inc.)	Magnolia, Arkansas
13	Elk Corporation of Arkansas	Stephens, Arkansas
14	Ethyl Corporation	Magnolia, Arkansas
15	Firestone Coated Fabrics Company	Magnolia, Arkansas
16	Georgia-Pacific Corporation, Crossett Div.	Crossett, Arkansas
17	Georgia-Pacific Corporation, Crossett Div.	El Dorado, Arkansas
18	Georgia-Pacific Corporation Hardwood Mill	Fordyce, Arkansas
19	Georgia-Pacific Corporation	Stamps, Arkansas
20	Great Lakes Chemical Corporation	El Dorado, Arkansas
21	Great Lakes Chemical Corporation	Marysville, Arkansas
22	International Paper Company (Inc.)	Camden, Arkansas
23	International Paper Company (Inc.)	Pine Bluff, Arkansas
24	MacMillan Ring-Free Oil Company, Inc.	Norphlet, Arkansas
25	Manville Forest Products Corporation	Huttig, Arkansas
26	Masonite Corporation	Warren, Arkansas
27	Monsanto Company (Inc.)	El Dorado, Arkansas
28	Potlatch Corporation	Warren, Arkansas
29	Potlatch Corporation	McGehee, Arkansas
30	Potlatch Corporation	Warren, Arkansas
31	Reynolds Metals Company	Benton, Arkansas
32	Superwood Corporation	North Little Rock, Ark.
33	Velsicol Chemical Corporation	El Dorado, Arkansas
34	Weyerhaeuser Company, Paper Mill	Pine Bluff, Arkansas
35	Willamette Industries, Inc.	Emerson, Arkansas

Source: Reference 13.

TABLE 1b

1/27/81

INDUSTRIAL CUSTOMER REQUIREMENTS

PROCESS STEAM PPH	PURCHASES FROM AP&L KW	PRESENT COGENERATION (CUSTOMER OWNED) KW	POTENTIAL NEW COGENERATION (ABOVE PRESENT COGENERATION) AP&L OWNED KW	CUSTOMER OWNED KW
1,100,000	0	80,000	290,000	0
950,000	12,060	20,000	315,000	12,000
800,000	6,760	30,000	300,000	0
375,000	8,808	20,000	100,000	0
364,000	22,599	10,000	95,800	16,200
250,000	40,067	72,000	62,500	25,000
250,000	12,774	------	62,500	8,800
240,400	1,941	------	60,000	8,000
200,000	1,274	------	50,000	7,000
200,000	6,486	------	50,000	7,000
120,000	5,344	------	30,000	3,000
100,000	1,371	------	25,000	4,000
100,000	5,252	------	25,000	4,000
100,000	6,184	------	25,000	4,000
89,000	2,936	------	22,250	2,225
80,000	5,262	------	20,000	2,000
75,000	1,917	------	18,750	1,875
70,000	2,631	------	17,500	2,000
70,000	2,984	------	17,500	1,750
70,000	1,588	------	17,500	1,750
55,000	4,113	------	13,750	1,375
50,000	2,900	------	12,500	1,250
45,000	3,644	------	11,250	1,125
45,000	844	------	11,250	1,000
35,000	5,895	------	8,750	921
35,000	1,638	------	8,750	700
35,000	3,256	------	8,750	820
28,000	2,089	------	7,000	560
25,000	2,483	------	6,250	500
22,850	461	------	5,700	457
20,000	4,240	------	5,000	455
12,000	1,961	------	3,000	290
10,000	432	------	2,500	200
9,500	562	------	2,375	190
9,500	995	------	2,370	200
6,040,250	183,751	232,000	1,713,495	120,641

Source: Reference 13.

replace the current U.S. fleet of 140 million passenger cars and light trucks with a fleet getting an average fuel economy of 60 mpg.*,[5,15,16] Yet Detroit has given no indication of interest in pushing the average fuel economy much beyond the 23 mpg on-the-road fuel economy that would result from the standards mandated for the 1985 model fleet. One way to push the market to higher fuel economy would be to give domestic manufacturers a tax credit for each car that is more energy efficient than the sales weighted average, with the magnitude of the tax credit proportional to the expected annual fuel savings. A substantial rebate could be provided by earmarking a tiny fraction of the revenues from a gasoline tax or oil import fee for these tax credits. For example, only a few percent of the $360 billion revenues that would be generated over 10 years from a $20/barrel tax on imported oil (@ 5 million barrels/day) would be adequate to fully finance the retooling necessary to convert automotive production lines to high fuel economy models.

- To expedite residential retrofits what is needed are firms which offer homeowners a "one-stop" energy efficiency retrofit package including: a diagnostic audit, a rank ordering of conservation investments by their cost effectiveness, and an offer to arrange for contractors, and any necessary financing, with a guarantee of the quality of work.

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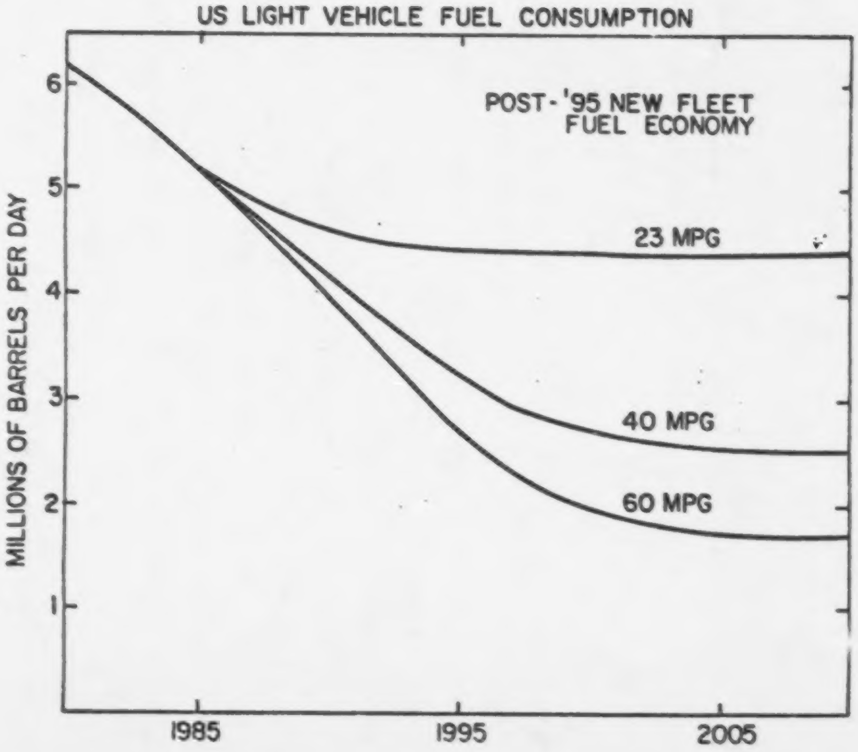
* The difference in national fuel requirements between 23 and 60 mpg (for the case of the same number of cars being driven the same number of miles each year) is the equivalent of about 2.5 million barrels per day after the fleet has turned over (see Figure 7). This is equivalent to 40% of the level of crude oil and natural gas liquids production projected by Exxon for the U.S. in the year 2000. The resulting oil import reduction would have a value (@ $35 a barrel) of $32 billion a year.

Figure 7



Source: Reference 16

The government could help establish a stable industry of such firms by supporting auditor and contractor training programs and by supporting "scorekeeping" efforts by local public agencies that could measure both the energy performance improvement and potential adverse side effects in statistical samples of retrofitted houses.

- Government could play a similar role in spurring the diffusion of innovative conservation technologies in the building construction industry. A good model of a very successful, relatively low cost venture of this sort is the recent Denver Metro Homebuilders Program sponsored by the Solar Energy Research Institute (SERI) and carried out in cooperation with the Denver Homebuilders Association. SERI solicited proposals from builder/architect teams for the design and construction of passive solar energy conserving houses, for which the training of the architects in passive solar and energy conserving techniques, the designs, and the post-construction performance monitoring, were to be supported by SERI. In June 1980 SERI selected the 13 winning builder/architect teams from among 47 bids. As of February, 1981, 12 of the 13 houses had been completed, and 15 houses had been presold on the basis of these designs. In the first two days of the open house tour of the 12 homes (February 21-22, 1981), the Homebuilders Association estimated that over 30,000 people visited the homes. Key to the success of this program is the fact that SERI's role was merely to provide needed information, allowing the builders maximum flexibility in design and construction. According to John Kurowski, a builder who is chairman of the Energy Committee of the Denver Homebuilders Association, this effort and the employed designs will serve as models for the entire housing industry of the Denver Metropolitan area.

Protecting the poor against the burden of high energy costs: Because of the extreme hardship of rising energy costs on the poor, the government has a major responsibility in providing direct assistance to the poor.

In particular this assistance should be an integral part of any energy tax shift program. There are a number of ways this could be accomplished in the design of the method by which the tax revenues are returned to the economy. For example, with a gasoline tax, a simple rebate to adults would result in an income transfer to the poor (see Table 2) - simply because many poor households do not have cars and those that do typically drive much less than the average household. But with a tax on all oil or on oil imports, it may be desirable to fashion a more progressive rebate, because, as shown in Table 3, the poorest oil heated households spend almost as much on heating oil as the average household.

Also, rental housing (which is often housing for the poor) should be singled out for special attention, because market strategies break down entirely when the person paying the fuel bills (the tenant) is different from the person who owns the property (the landlord). And markets often work poorly even if the landlord pays the bills. Landlords can usually pass on fuel cost increases to their tenants, while the tight housing market in many areas makes energy costs a relatively minor consideration for most prospective tenants. Also, in a number of communities, restrictions in rent-control ordinances may make it difficult for landlords to pass costs and savings through to their tenants in an equitable fashion. Building energy performance standards or tax subsidies should be seriously considered for rental housing, which accounts for 1/3 of all households and 1/4 of all residential energy use.

TABLE 2

NET INCOME EFFECTS OF A $1.34 GASOLINE TAX WITH AN EQUAL REBATE OF REVENUES TO ALL ADULT PERSONS*

	Income Group**					
	$0 to $7,300	$7,301 to $14,600	$14,601 to $21,379	$21,380 to $29,282	$29,283 to $36,600	Over $36,600
Tax Paid Per Household	$ 718	$1,110	$1,402	$1,632	$2,005	$2,015
Rebate Received Per Household	$1,340	$1,340	$1,340	$1,340	$1,340	$1,340
Income Transfer Per Household	+$ 622	+$ 230	-$ 62	-$ 292	-$ 665	-$ 675

*Adult persons defined to be all individuals 16 years or older.
**1980 dollars.

Source: Carmen Difiglio, "Economic Allocation of Gasoline Shortages," paper prepared for the National Energy Users Conference for Transportation, Transportation Research Board, San Antonio, Texas, April 13-16, 1980

Table 3

Expenditures on Household Heating Oil Use by Income Group

Number of Households (millions)	1978 Family Income	Expenditures for the Period April 1979 through March 1980 (dollars)
1.2	Less than $5,000	577
2.0	$5,000 to $9,999	638
2.2	$10,000 to $14,999	692
1.5	$15,000 to $19,999	669
1.9	$20,000 to $24,999	699
1.6	$25,000 to $34,999	747
2.0	$35,000 or more	1024
12.3	Average	710

Source: Energy Information Administration, Residential Energy Consumption Survey: 1979 - 1980 Consumption and Expenditures, Part I: National Data, April 1981

Supporting research on energy efficiency: The conventional view is that energy conservation is a stopgap measure. One often hears the appeal, "Conserve...till we can build more." Yet with an adequate commitment to research, new conservation opportunities can continue to unfold for decades to come. Figure 8, which shows the evolution of the thermal efficiency of electric power plants in the U.S. from the turn of the century till the present, represents in broad terms the history of our technological efforts relating to energy supply. By focusing enormous resources on the supply side we achieved a remarkable 8-fold improvement in the thermal efficiency of power generation in 60 years; but as this "learning curve" shows, it has become exceedingly difficult to make further improvements. In the area of conservation we are still at the beginning of this "learning curve", as a list of "second law" efficiencies for various energy end uses indicates (see Table 4).

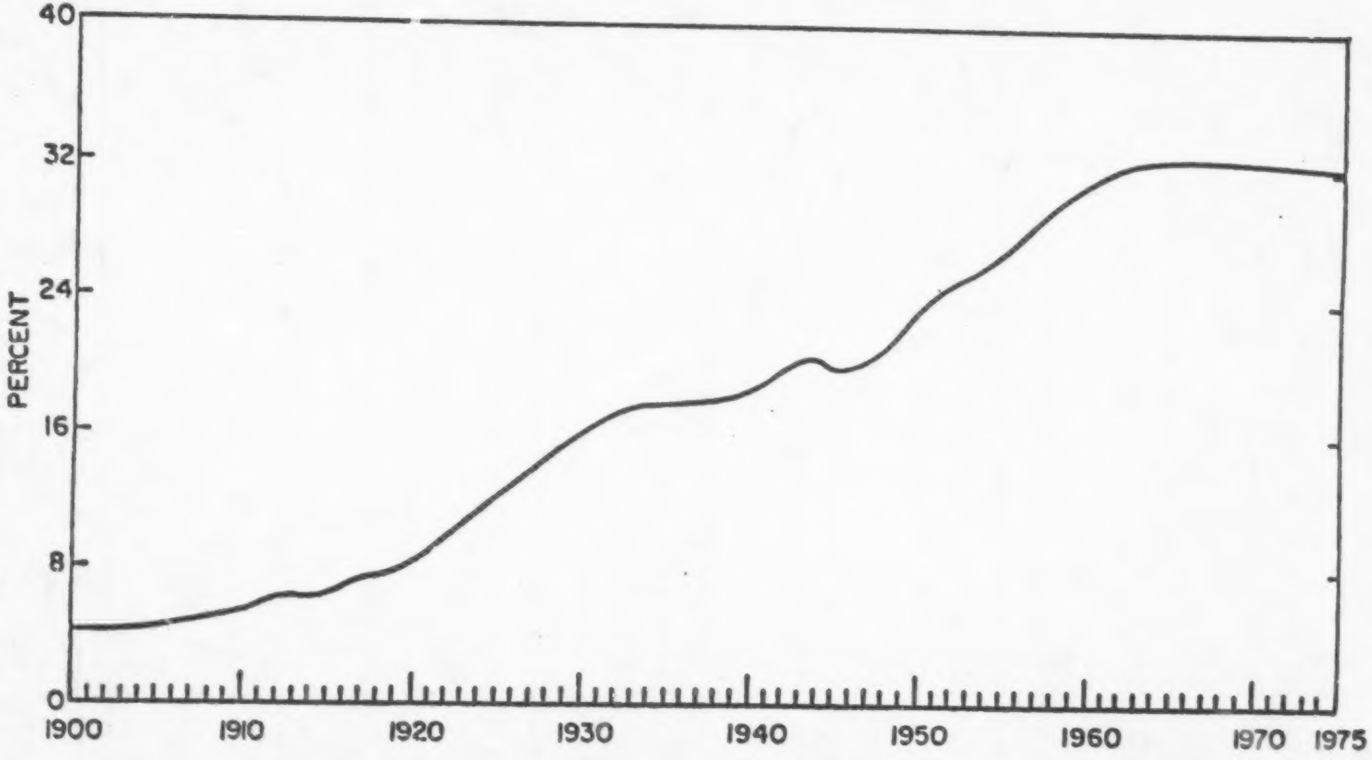
Much of the advanced product development, demonstration, and commercialization aspects of promoting advanced conservation technology can be carried out in the private sector. Government should use tax incentives to create an economic climate conducive to such private sector research and development efforts.

At the same time there is much needed research that the government should support directly because the private sector is unlikely to do so. Some examples:

- The development of diagnostic and analytical techniques for monitoring energy performance and potential hazards of energy conservation measures.

- Field monitoring and analysis of the energy performance and potential hazards of a wide range of conventional and innovative energy conservation measures.

Figure 8. Average Steam Electric Power Plant Efficiency



Source: Robert H. Williams, "Industrial Cogeneration," Annual Reviews of Energy, 1978.

Table 4 Second-law Efficiencies for Typical Energy-consuming Activities

SECTOR	SECOND-LAW EFFICIENCY (PERCENT)
1. Residential/commercial:	
Space heating:	
Furnace	5
Electric resistive	2½
Air conditioning	4½
Water heating:	
Gas	3
Electric	1½
Refrigeration	4
2. Transportation: Automobile	12
3. Industry:	
Electric-power generation	35
Process-steam production	28
Steel production	23
Aluminum production	13

Source: M. Ross and R. Williams, Our Energy/Regaining Control

- Development of hazard mitigation and avoidance strategies for various conservation technologies (development of prototypes of safe small cars, development of particulate air pollution control strategies for diesel engines, development of control strategies for indoor air pollution, etc.)

- Development of an understanding of consumer behavior relating to different conservation measures and conservation marketing approaches.

- Applied research, i.e., fundamental research on topics selected for their technological importance. Friction and lubrication, and combustion of inhomogeneous fuel-air mixtures in internal combustion engines are examples of problem areas relevant to fuel conservation for which new research could provide valuable funds of knowledge on which improved product designs could be based. This kind of applied research, vital to the long term viability of the U.S. industrial base, is sadly neglected in present R & D programs.

- An ongoing assessment of the least cost opportunities for energy conservation in all sectors, updated continually in light of new technological developments and as better data become available on actual energy performance in the field. "Least cost scenarios" can then be used to provide a benchmark for assessing real world performance, as determined from "scorekeeping programs."

A complementary long-range objective of the energy R & D program should be to provide the appropriate technical manpower for the kinds of innovation needed. Our present technical educational system emphasizes fields which grew out of World War II military research: electronic, nuclear, and aerospace technologies. The schools of engineering have been shaped by federal support of research in these areas. Subjects such as production engineering, process engineering (e.g., for basic materials like steel and paper), and more basic topics like convective heat transfer and lubrication are moribund at most of our universities. A veritable renaissance of skills development and research related to society's basic technology is required.

* * *

The energy conservation policy I have described here involves far more government initiatives than just the decontrol of oil and gas prices. Yet the overall proposed program should be appealing to the new Administration, because if it were adopted it would signal a fundamental change in energy policy - away from the present trend to central planning and toward a greater reliance on market-mechanisms for shaping the course of energy related development. In this market-oriented program the primary role of government would be to try to eliminate market imperfections and to create an economic climate conducive to individual choice. The program should also not be very costly - it involves no big ticket energy projects; it requires far more intelligence than money from the government. Aside from this philosophical appeal, perhaps the most important appeal of all is that any serious plan for economic recovery must involve reducing the nation's retail energy bill. The only way this can be accomplished is to adopt a least cost energy strategy, to ensure that a significant fraction of the nation's total energy budget would be relatively low-cost "saved energy," to offset the staggering costs associated with new energy supplies. There is no other way for the Nation to regain control of its energy system.

Notes and References

1. The Economics of Saved Energy in the Bowman House

Conservation measure	Investment[c] (dollars)	Savings[a,b] (per cent)	Cost of saved energy[c] (1978 $/gal.)
1 Storm windows	780	25	0.32
2 Wall insulation	840	20	0.44
3 Floor insulation	480	7.5	0.67
4 Added attic insulation[d]	550	6	0.95
1 + 2	1620	45	0.37
1 + 2 + 3	2100	52.5	0.42
1 + 2 + 3 + 4	2650	58.5	0.47

a The Bowman house, (with a floor area of 2054 sq. ft.) initially had insulation only in the attic (3½ inches) and double glazing only on a living room picture window; all other windows had single glazing. Before the storm windows and insulation were added, efforts were made to reduce air infiltration by caulking, weather-stripping, etc. This effort (which cost $190) resulted in no measurable savings. This is probably because the house was quite airtight to begin with, having an air exchange rate of 0.2 to 0.6 air exchanges per hour. A more typical house has 1 to 2 air exchanges per hour. (See *D.M. Burch and C.M. Hunt.*)

b The savings are relative to a pre-retrofit annual consumption level of 990 gallons of oil. The furnace efficiency is 55%.

c The proper evaluation of capital and operating costs requires their comparison on the same footing. The method of evaluation used here facilitates that comparison by assuming equal loan payments in constant dollars for each year over the life of the loan. The levelized annual payment P (in dollars/year) on a loan L with an interest rate i and a term of N years is:

$$P = \frac{L}{1-(1+i)^{-N}}$$

For i = 0.06 (the "real" interest rate for a home-improvement loan with a nominal 12% interest rate and a 6% annual inflation rate) and N = 15 years, P = 0.103L. For an annual fuel savings S (in gallons/year) associated with an investment L, the cost of saved energy is:

$$C = 0.103L/S \text{ dollars per gallon.}$$

d Six inches of loose fill cellulose insulation were blown on top of the existing 3½-inch glass fiber blanket in the ceiling. The costs of saved energy associated with installing attic insulation where none exists initially would be much less than the cost shown here.

Source: R.H. Williams and M.H. Ross, "Drilling for Oil and Gas in Our Houses," Technology Review, March/April, 1980.

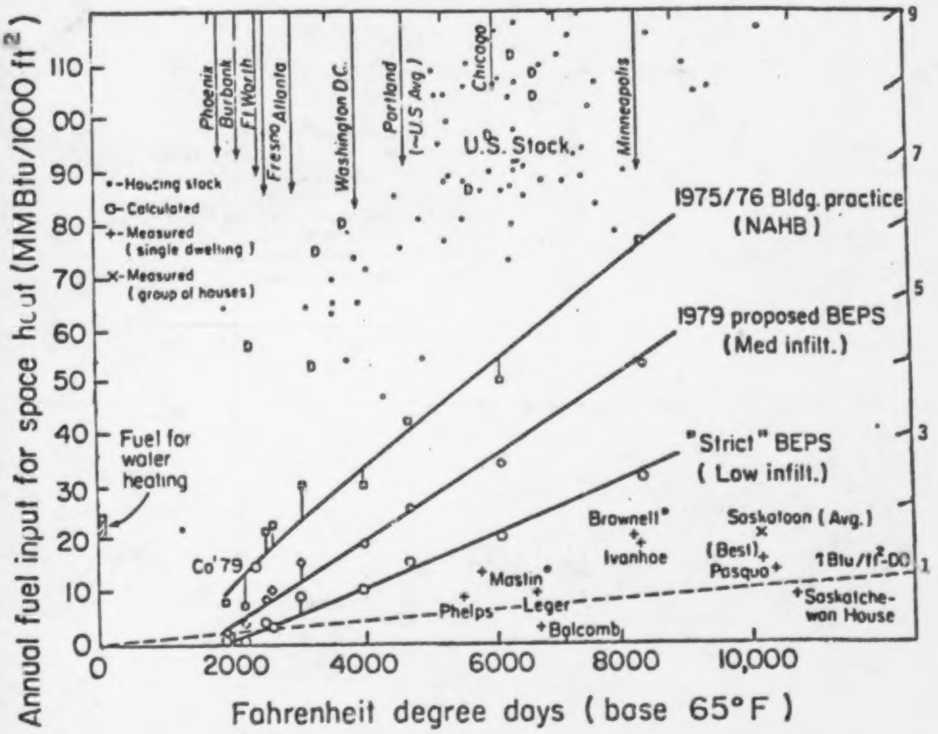
2. Here the cost of saved energy is calculated as in note 1. The data were obtained from Richard Grot of NBS, private communication.

3. For a new house the real interest rate (corrected for inflation) is taken to be 3% and the life of the investment is taken to be 20 years, so that the cost of saved energy (see note 1) is:

$$C = 0.067\ L/S$$

R-2

From the following figure the cost of improving the energy performance of new houses in an average climate (4800 degree days) from 1975/76 building practice to the 1979 proposed BEPS performance level is \$1000 per 1000 ft^2, resulting in an annual fuel savings of 15 million Btu per 1000 ft^2.



Annual fuel input for space heat in single-family US homes. Dots are actual gas sendout to residential customers for space heat for calendar 1978. 1979 proposed BEPS leaves infiltration at current practice levels of 0.6 air changes/hour (ach); strict BEPS reduces infiltration to 0.2 ach but restores 0.4 ach with mechanical ventilation through a heat exchanger. Approximate extra costs for conservation above 1975/76 practice: BEPS, \$1000; tight BEPS - \$1500; better-than-BEPS houses: several hundred to several thousand dollars. Source: A. H. Rosenfeld et al., BECA-A: Building Energy Use Compilation and Analysis, LBL 8912, submitted to Energy and Buildings, 1980.

4. The following figure shows that for about $75 in 1975 dollars ($107 in 1980 dollars) the electricity requirements of a frost free refrigerator could be reduced by 910 kwh/year (8.8 million joules/day). With a 10-year term home improvement loan the cost of saved energy for this improvement would be

$$C = .136\ L/S = 1.6\ ¢/\text{kwh}\ (1980\ \$)$$

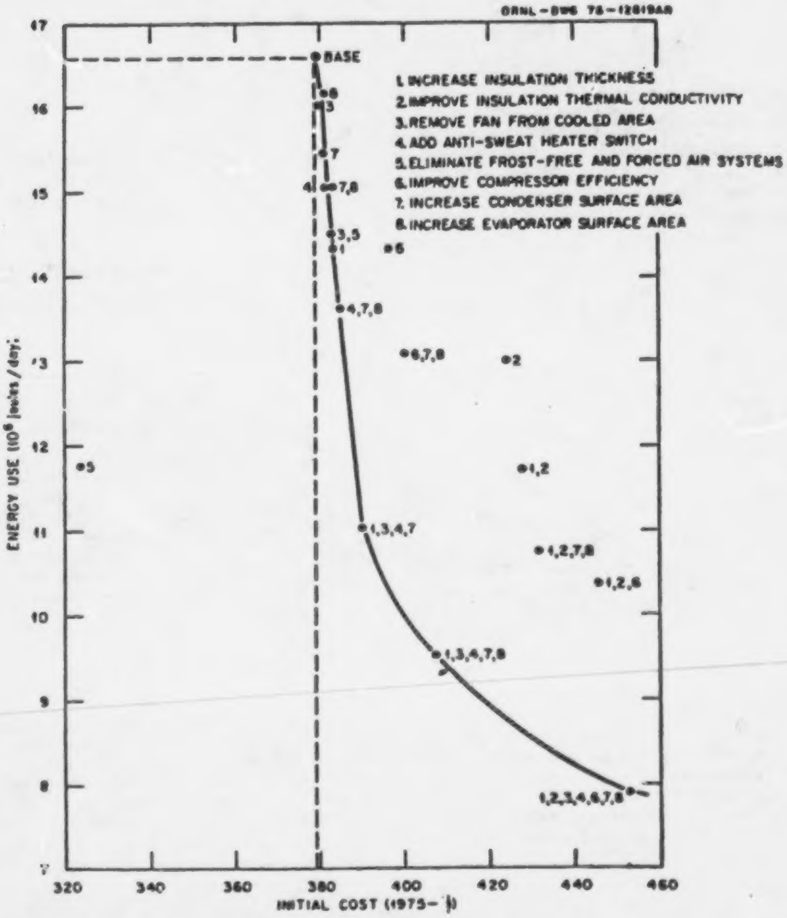


Figure 1. Energy use vs. retail price for various design changes for a 0.45 m^3 (16 ft^3) top-freezer refrigerator.

Source: R.A. Hoskins and E. Hirst, "Energy and Cost Analysis of Residential Refrigerators," Oak Ridge National Laboratory Report, No. ORNL/CON-6, January 1977.

5. The Solar Energy Research Institute, Building a Sustainable Future, Committee Print 97-L of the Committe on Energy and Commerce, U.S. House of Representatives, April 1981, pp. 742-750 in vol. 2.

6. The following is an estimate of the percentage of income spent directly on energy at 1980 price levels for low income and average income households.

	Energy Consumption in the Year April 1978-March 1979	Actual Expenditures in the Year April 1978-March 1979 (1977 $)	Expenditures for 1980 Prices and April 1978-March 1979 Consumption Levels (1977 $)	Estimated Actual Expenditures for 1980 Prices (1977 $)[g]
1977 Income less than $5000[a]				
Household Fuel	642 gallons of fuel oil equivalent[b]	262[b]	349[f]	
Electricity	5550 kwh[b]	214[b]	237[f]	
Gasoline	276 gallons[c]	171[f]	269[f]	
TOTAL		647	855[h]	809[h]
Percent of Income		22.1%	29.2%	27.6%
Average 1977 Income ($16,100)				
Household Fuel	763 gallons of fuel oil equivalent (b)	305[b]	412[f]	
Electricity	9440 kwh[b]	356[b]	404[f]	
Gasoline	834 gallons[e]	515[f]	814[f]	
TOTAL		1176	1630	1527
Percent of Income		7.3%	10.1%	9.5%

Notes

(a) There were 11 million households (14% of all households) having incomes less than $5000 in 1977. According to Statistical Abstract 1979, p. 460, the average income per household in this group was $2928 in 1977.

(b) Residential Energy Consumption Survey, Consumption and Expenditures, April 1978 through March1979, DOE/EIA-0207/5, July 1980.

(c) From ref. d it is estimated that at a 1978 income level below $5000 the average household vehicle miles traveled was 3680 in 1978. (This average is over all households, including households without cars.) Gasoline consumption is estimated by assuming a fuel economy of 14 mpg.

(d) Table 2.37, p. 2-52, in G. Kulp et al, Transportation Energy Conservation Data Book: Edition 4, ORNL-5654, September 1980.

(e) From ref. d. it is estimated that for a household with average income the average vehicle miles traveled was 11,680 in 1978.

(f) Energy prices were obtained from "Monthly Energy Review," various issues.

(g) Here it is assumed that at a given income level

$$\text{energy consumption} = \text{constant} \times (\text{price})^{\alpha}.$$

The price elasticity α is estimated as the average for the residential/commercial sectors during the period 1973-1980. In note 7 it is estimated that $\alpha = -0.2$.

(h) The average 1980 expenditure expressed in 1980 dollars would be $1013 per poor household.

7. The price elasticity of energy demand for the Residential/Commercial sector as a whole is estimated from the following data:

	Energy Consumption in the Residential/ Commercial Sectors (10^{15} Btu)	Average Energy Price		GNP	GNP Deflator
		Current \$ Per Million Btu	1980 \$ Per Million Btu	(10^9 1972\$)	(1980 = 100.00)
1973	27.4	1.52	2.55	1255	59.59
1974	26.7	1.99	3.07	1248	64.79
1975	26.6	2.30	3.25	1234	70.79
1976	27.8	2.59	3.48	1300	74.49
1977	28.2	2.95	3.74	1372	78.84
1978	28.8	3.12	3.69	1437	84.60
1979	29.3	3.59	3.91	1483	91.77
1980	29.1	4.66	4.66	1481	100.00

From the above data the price elasticity of energy demand α can be estimated, assuming:

$$\text{Energy consumption} = \text{Constant X GNP X (Average Energy Price)}^{\alpha}$$

Thus one obtains $\alpha = -0.2$.

8. "Conservation: Loopholes and Care Packages," Electrical World, p. 31, January 1981.

9. The following table is obtained from Office of Management and Budget, "Special Analysis G: Tax Expenditures", Reprint of Pages 203 through 238 from Special Analyses, Budget of the United States Government, 1982, January 1981.

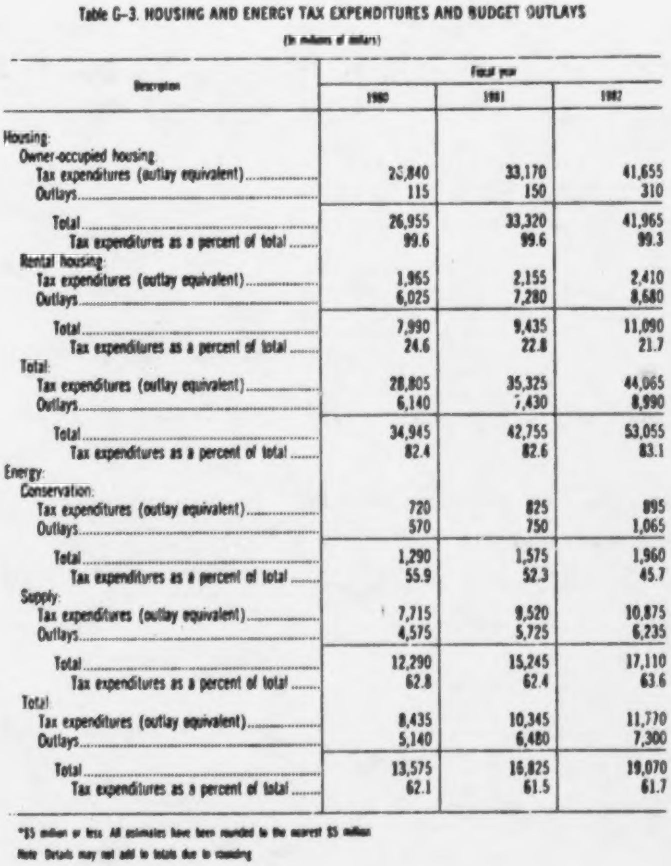


Table G-3. HOUSING AND ENERGY TAX EXPENDITURES AND BUDGET OUTLAYS

(In millions of dollars)

Description	Fiscal year		
	1980	1981	1982
Housing:			
Owner-occupied housing:			
Tax expenditures (outlay equivalent)	26,840	33,170	41,655
Outlays	115	150	310
Total	26,955	33,320	41,965
Tax expenditures as a percent of total	99.6	99.6	99.3
Rental housing:			
Tax expenditures (outlay equivalent)	1,965	2,155	2,410
Outlays	6,025	7,280	8,680
Total	7,990	9,435	11,090
Tax expenditures as a percent of total	24.6	22.8	21.7
Total:			
Tax expenditures (outlay equivalent)	28,805	35,325	44,065
Outlays	6,140	7,430	8,990
Total	34,945	42,755	53,055
Tax expenditures as a percent of total	82.4	82.6	83.1
Energy:			
Conservation:			
Tax expenditures (outlay equivalent)	720	825	895
Outlays	570	750	1,065
Total	1,290	1,575	1,960
Tax expenditures as a percent of total	55.9	52.3	45.7
Supply:			
Tax expenditures (outlay equivalent)	7,715	9,520	10,875
Outlays	4,575	5,725	6,235
Total	12,290	15,245	17,110
Tax expenditures as a percent of total	62.8	62.4	63.6
Total:			
Tax expenditures (outlay equivalent)	8,435	10,345	11,770
Outlays	5,140	6,480	7,300
Total	13,575	16,825	19,070
Tax expenditures as a percent of total	62.1	61.5	61.7

*$5 million or less. All estimates have been rounded to the nearest $5 million.

Note: Details may not add to totals due to rounding.

10. Robert H. Williams, "Industrial Cogeneration," Annual Review of Energy, vol. 3, pp. 313-356, 1978.

11. South Coast Technology Inc., "Review of Improved Lubricants," in Automotive Fuel Economy Contractor's Coordination Meeting Summary Report, April 24-26, 1978. p. II-A-19, U.S. DOT Report No. DOT HS-803 362.

12. TRW, Energy Systems Planning Division, Appendix: Data Base on Automobile Energy Conservation Technology, p. 63, Draft, Dept. 25, 1979.

13. Wieble Alley, Manager, Energy Applications, Arkansas Power and Light, "The Use of Advanced Technologies by Electric Utilities to Expand and Extend the Use of Cogeneration," paper present at the Center for Energy and Environmental Studies, Princeton University, June 19, 1981.

14. Robert H. Williams, "Marketing Energy Efficient Appliances," Center for Energy and Environmental Studies draft report, June 4, 1981.

15. Charles Gray and Frank von Hippel, "The Fuel Economy of Light Vehicles," Scientific Amercian, pp. 48-59, May 1981.

16. Frank von Hippel, "Why the U.S. Needs an Automotive Fuel Economy Policy," testimony before the Subcommittee on Energy Conservation and Power, House Energy and Commerce Committee, June 24, 1981.

August 11, 1981

A CRITIQUE OF THE ENERGY CONSERVATION ASPECTS OF THE NATIONAL ENERGY POLICY PLAN

Answers to Questions Concerning the NEPP Posed by Senator Charles Percy

Material Supplementing Testimony

by

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before the

Subcommittee on Energy, Nuclear Proliferation, and Government Processes

of the

Senate Committee on Governmental Affairs

July 21, 1981

1 & 2. Question: The Reagan Administration's National Energy Policy Plan asserts that "achieving a low level of U.S. oil imports at any cost is not a major criterion for the nation's energy security and economic health". Could you please comment on this statement and its implications for conservation policy? Also, the National Energy Plan projects net oil imports to be at 6 to 7 million barrels per day in 1985 and 4 to 5 million barrels per day in 1990. Do you agree with these projections? Do you think we would be doing well as a nation if we were still importing that much oil in those years?

1 & 2. Answer: An important goal for energy policy should be to substantially reduce oil imports, because so doing would be a major step toward bringing energy costs under control. In contrast, the NEPP envisions a continuing energy cost spiral.

The world oil price is projected (in the midrange case) to increase continuously as follows:[1]

	(1980 $/bbl)*
1980	33.89
1985	40.0
1990	47.3
2000	63.7

And the rising world oil price contributes upward pressure on all energy prices. Indeed the NEPP projection implies that the increase in the price of energy, averaged over all forms, will be about as great

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Note: All prices and costs presented in answers to Senator Percy's questions are in 1980 dollars.

between 1980 and 1990 as between 1973 and 1980 (see Table 1). Moreover, retail expenditures on energy are projected to increase from about $390 billion in 1980 to about $630 billion (or 18% of GNP) in 1990, with only a 14% increase in primary energy use (see Table 1). The increase in the nation's retail energy bill between 1980 and 1990 would be 20% more than the $200 billion increase between 1973 and 1980 (see Table 1).

A strong energy conservation effort offers the only hope of bringing energy costs under control. Costs could be dramatically reduced not just because it is cheaper to save a barrel of oil equivalent energy through energy efficiency improvements than to produce a new barrel of energy supply, but also because saving oil and thereby reducing oil imports can be effective in curbing the world oil price spiral and the impacts of world oil price increases on all energy prices.

Unilateral efforts by the U.S. can be very effective in moderating the world oil price, as recent experience has shown. The softening of the world oil price this year is due in large part to conservation efforts in the U.S. Indeed, over half of the reduction in "Free World" oil demand between 1979 and 1980 was accounted for by the U.S. The U.S. has so much leverage because a relatively modest fractional reduction in U.S. oil demand is globally significant. As shown in Table 2, the reduction in U.S. imports achieved in 1980 is comparable to the total petroleum consumption in many other industrialized countries or alternatively to the total petroleum consumption of large segments of the Third World. For the near term future, variations in the level of Free World oil demand of ± 1 1/2 million barrels/day relative to the expected 1981 level of 47 - 47 1/2 million barrels per day define the range over which world oil supplies vary from

Table 1. NEPP Projection for the U.S. Energy Budget in 1990

	Energy Consumed at the Point of End Use (Quads/year)	Midrange Price(a) (1980 $/$10^6$ Btu)	Energy Expenditures (Billions of 1980 $)
Residential(i)			
Oil	2.0	10.74	21.5
Natural Gas	5.1	8.00	40.8
Coal	0.2	1.86(c)	0.4
Renewables	0.4	10.74(d)	4.3
Electricity	2.9	18.10	52.5
Subtotals	10.6		119.5
Commercial(i)			
Oil			
Refined	1.5	8.98(e)	13.5
Asphalt	1.0	8.03(f)	8.0
Natural Gas	2.6	7.73	20.1
Coal	0.1	1.86	0.2
Renewables	0.3	9.93(d)	3.0
Electricity	2.3	19.02	43.7
Subtotals	7.8		88.5
Industrial(j)			
Oil	5.8	9.31(g)	54.0
Natural Gas	9.9	7.28	72.1
Coal	5.2	1.86	9.7
Renewables	1.8	9.70(d)	17.5
Electricity	4.4	13.83	60.9
Subtotals	27.1		214.2
Transportation(k)			
Motor Gasoline	8.5	13.36	113.6
Jet Fuel	2.2	10.50	23.1
Distillate	4.6	10.98	50.5
Residual Oil	1.1	7.76	8.5
Other Oil	0.3	10.98(d)	3.3
Alcohol	0.2	13.36(h)	2.7
Natural Gas	0.7	7.73	5.4
Subtotals	17.6		207.1

	I Total Primary Energy Use (Quads/year)	II Total Energy Expenditures (Billions of 1980$)	III Average Energy Price(l) (1980 $ Per 10^6 Btu)
1973	74.6	190	2.55
1980	76.2	390	5.10
1990	87.0	629	7.25

Notes

(a) Prices are obtained from Table 1-5, p. 1-13, in ref. b.

(b) Office of Policy, Planning, and Analysis, U.S. DOE, Energy Projections to the Year 2000, a Supplement to the National Energy Policy Plan, July 1981. Prices given in 1981 $ in Tables 1-5 are converted to 1980 $ by dividing by 1.099.

(c) The industrial coal price.

(d) Assumed to have the same price as distillate oil.

(e) A 50/50 mix of distillate and residual oils is assumed.

(f) The price of asphalt is assumed to be equal to that of residual oil.

(g) Assumed to be 20% residual and 80% distillate.

(h) Assumed to cost the same as gasoline.

(i) For end use energy consumption projections, see Table 4-5, p. 4-9, in ref. b.

(j) For end use energy consumption projections, see Table 4-10, p. 4-17, in ref. b.

(k) For end use energy consumption projections, see Table 4-13, p. 4-24, in ref. b.

(l) The average energy price is defined as the total energy expenditures (column II) divided by the total primary energy use (column I).

Table 2. Comparison of Foreign Oil Requirements with the Recent U.S. Oil Import Reduction

	Oil Level(Million B/D)		
	1979	1980	Change
U.S. Imports[a]	8.0	6.3	-1.7
Foreign Consumption			
Canada[a]		1.7	
France[a]		2.0	
Italy[a]		1.6	
United Kingdom[a]		1.4	
West Germany[a]		2.3	
South America[b]		2.6	
Africa[b]		1.3	
China[b]		1.7	

Notes

(a) Energy Information Administration, Monthly Energy Review, May 1981.

(b) For these countries consumption data are for 1978. See Energy Information Administration, Energy Data Report: International Petroleum Annual 1978, April 11, 1980.

so tight that there would be strong upward price pressure to a glut condition in which there could be problems in allocating production cutbacks among the various members of OPEC.[2,*] Given the high level of oil use by the U.S. and the vast potential for energy efficiency improvement, it is clear that the U.S. has the capability to sustain the present oil glut for many years to come.

But the NEPP does not seize this opportunity. Instead NEPP envisions (for the midrange case) that oil imports will increase from the early 1981 level of 5.7 million barrels/day (average for January - April) to 6.3 million barrels/day by 1985. Moreover, the reduction to 4.8 million barrels/day by 1990 is both modest in an absolute sense and optimistic in the context of the NEPP U.S. oil demand projection.

The 1990 target is modest because it is cost effective to seek much more than a 1 million barrel per day reduction in oil imports. Here only a few examples will be given that show how further oil savings could be achieved:

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[*] In reference 2 it is argued that the key to the future of OPEC prices, at least for the near term, lies with Saudi Arabia and with Iran and Iraq, because the near term output of the other "inflexible 10" members of OPEC is narrowly constrained by financial needs. It is argued that the minimum level of production that Saudi Arabia would be comfortable with on a sustained basis is 5 1/2-6 million barrels per day. (Saudi Arabia's current spending plans can be funded with about 5.2 million barrels per day of production). While Saudi Arabia produced at a rate of 10.2 million barrels per day in the first quarter of 1981, the combined production of Iran and Iraq could increase from the early 1981 level of 2.6 million barrels per day to as high as 6 million barrels per day in the next year or so, if a face-saving means can be found to end the war. (In 1979 the combined production of Iraq and Iran was 6.6 million barrels per day. The peak combined production of the two countries was 8.3 million barrels per day in 1976.)

- The NEPP projection for the average on-the-road fuel economy (mpg) for new passenger autos and light trucks is as follows:

	passenger autos	light trucks
1990	24.8	16.9
2000	29.7	19.9

These correspond to an average fuel economy for all passenger autos and light trucks on the road of 22 mpg in 1990 and 26 mpg in 2000. It has been shown that the average on-the-road fuel economy of new cars and light trucks could be raised by 1995 to 60 mpg for a cost of saved gasoline of $1.00 per gallon or less.[3] The achievement of this 1995 goal implies that the on-the-road fuel economy for all light vehicles would instead be 25 mpg in 1990 and 50 mpg in 2000, corresponding to a fuel savings, (relative to the NEPP projection) of 0.6 million barrels per day in 1990 and 2.5 million barrels per day in 2000.

- If the best available synthetic oils with antifriction additives were put into all automotive engines and transmissions and if radial tires with the lowest rolling resistance were used on all autos, the result would be at least a 10% fuel savings today (0.5 million barrels per day) and of the order of 5% savings in 1990 (0.2 million barrels per day).[4,5] (Note: The savings in 1990 would be less because the energy efficiency of the average oils and tires in use will increase over time.)

- The NEPP projects that oil use for space heating in residential and commerical buildings will be reduced only 20% (per residential dwelling and per square foot of commercial space) over the next 10 years. This projection reflects a judgment that only very modest investments in energy efficiency will be made. Yet in light of present and expected future oil prices, much higher fuel savings are cost-justified. For new houses, savings of the order of 67% - 80% relative to fuel use in average existing houses are cost-justified.[6] (The NEPP projects that about 20% of new houses built in the period 1980-1990 will be oil-heated). And even in existing houses that are already partially insulated, investments targetting further savings of 50% - 60% are cost-justified. Such savings can typically be achieved with investments of the order of $2000 (4 year payback).[7] If the oil savings for space heating were increased from 20% to 50% for the average oil heated building, the additional oil savings at the national level would be 0.5 million barrels per day by 1990. Similarly, investments in gas-heated buildings that reduce space heating fuel use to 50% of 1980 levels would save another 1.0 million barrels per day of oil equivalent. (The savings of natural gas in buildings would free up gas supplies to displace oil in industry).

A comprehensive list of the major opportunities to save oil would also include the possibilities for energy efficiency improvement in trucking, for shifting long-distance freight traffic from truck to rail, for reducing utility and industrial use of oil with cogeneration,* for introducing more energy efficient industrial processes, etc. However, the three measures considered explicitly here alone would yield by 1990 direct oil savings of 1.3 million barrels/day and additional natural gas savings equivalent to 1.0 million barrels per day. These savings translate into a reduction in our oil import bill of $40 billion a year as a direct result of oil savings and a possible further $12 billion reduction if U.S. conservation efforts are successful in stabilizing the world oil price at the 1980 level.

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* For a discussion of how an innovative utility-based cogeneration strategy could be used to shift small industrial boilers away from oil, see the note at the bottom of p. 16.

The 1990 NEPP target for oil imports is also optimistic in the context of the NEPP, because the NEPP estimate of domestic oil production by 1990 may be optimistic. The NEPP projects a midrange value for domestic crude oil and natural gas liquids production in 1990 of 8.7 million barrels per day. The NEPP midrange value is at the high end of various projections that have been made recently by various government and industry groups (see Table 3). Moreover, there is clearly much more uncertainty in the 1990 domestic production level than NEPP projects (8.0 to 9.8 million barrels per day). Indeed, the simple average of 7 major projections made recently by various government and industry groups (7.8 million barrels per day - see Table 3) is less than the lower limit projected in NEPP. If this simple average production level were realized instead of the NEPP midrange value, the import level in 1990 would be the same as the level in early 1981. Moreover, if one of the more pessimistic projections of Table 3 is borne out, the import level could rise significantly above the present level. Of course, no one can predict with great confidence what the actual domestic production level will be in 1990. The key public policy issue is how to deal with the uncertainty involved. Fortunately, the strategy that minimizes the risks associated with this uncertainty is also the least costly strategy: an energy conservation strategy aimed at minimizing the total cost of energy production and use.

There are also important national and global security benefits associated with substantially reduced U.S. oil imports. Not only would the U.S. experience a smaller reduction in its oil supply in the event of a supply disruption, but also the condition of a "soft" world

Table 3. Alternative Projections of Domestic Oil Production [(a)]
(million barrels per day of crude oil and natural gas liquids)

	1985	1990
NEPP Projection	8.6-9.8	8.0-9.8
Alternative Projections		
Office of Technology Assessment (October 1980) [(b)]	7.2-8.6	5.3-7.6
General Accounting Office (Dec. 1979) [(c)]	8.9	8.0
Congressional Budget Office (May 1980) [(d)]	9.4	8.6
Exxon (Dec. 1979) [(e)]	7.9	6.1
Shell (June 1980) [(f)]	8.5	8.4
Scallop Corporation (July 1980) [(g)]	9.2-9.7	8.0-8.5
Petroleum Industry Research Foundation (May 1980) [(h)]	9.4	9.0
SIMPLE AVERAGE OF 7 ALTERNATIVE PROJECTIONS	8.8	7.8

Notes

(a) The 1980 production level was 10.2 million barrels per day. See Monthly Energy Review, May 1981.

(b) Office of Technology Assessment, World Petroleum Availability 1980-2000, a Technical Memorandum, October 1980.

(c) Report by the Controller General to the Congress of the United States, "Analysis of Current Trends in U.S. Petroleum and Natural Gas Production," United States General Accounting Office, December 7, 1979.

(d) Congressional Budget Office, "The World Oil Market in the 1980's: Implications for the United States," May 1980.

(e) Exxon Company, "U.S.A.'s Energy Outlook, 1980-2000," December 1979.

(f) "Shell: U.S. Oil Use to Hit 17.2 - Million - B/D Plateau in '80's," Oil and Gas Journal, June 9, 1980.

(g) Scallop Corporation, "World Oil Outlook," July 1980.

(h) Petroleum Industry Research Foundation, Inc., "Oil in the U.S. Energy Perspective - a Forecast to 1990," May 1980.

oil market makes it more likely that other producers can increase output to compensate for a supply cutoff arising from a potential disruption involving one or more supplier countries. The result is that the entire Free World's vulnerability to oil supply disruption is reduced. The risk of outside armed intervention and the associated potential for the resulting conflict escalating into nuclear war can be greatly reduced if world oil supplies are not tight when political turmoil erupts in some unstable oil supply region.

Still another national security benefit of energy conservation is the potential for dispersed stockpiling implicit in a serious conservation effort. Consider the nation's 18 million oil and LPG heated homes, which account for 1 million barrels of oil per day.[8,9] The oil heated homes have oil storage tanks with an average storage capacity of 333 gallons (see Table 4). At the present average consumption rate of 812 gallons per year,[8] 2 1/2 fills per year are required. But if energy efficiency investments were made to reduce consumption by 60% and if consumers were encouraged to keep their tanks full (so doing would provide a hedge against oil inflation), the result would be an effective 0.4 billion barrel "Dispersed Strategic Petroleum Reserve" that would be able to meet residential oil needs for one year.[10] This energy security strategy would pay for itself in oil savings in 3 to 5 years. It is hard to imagine a more cost-effective way of achieving a high degree of energy security.

Table 4. Estimated Storage Tank Capacity for Single-Family Households, August 1979*

Tank Capacity**	Percent of Households Total U.S.	Standard Error
All Single-Family Households		
Less Than 200 Gallons	7	1
200 to 399 Gallons	73	3
400 to 699 Gallons	18	2
700 and Over	3	1
TOTAL	100	
Average Tank Capacity	333	21

*Represents single-family fuel oil households who plan to use fuel oil as their main heating fuel in the winter of 1979-1980.

**The standard tank sizes for single-family units are 275 and 500 gallons.

Source: Energy Information Administration, Single-Family Households: Fuel Oil Inventories and Expenditures, National Interim Energy Consumption Survey, December 1979.

3. Question: The National Energy Policy Plan indicates that there will be a need to increase the electrical generating capacity of power plants, while making no mention of the alternative of investing in cogeneration, load-leveling, or other conservation technologies in the utility sector. Will you please comment on the degree to which conservation could offset the need for new generating capacity and outline for us which conservation measures you find most promising?

3. Answer: The NEPP projects that electricity demand will grow till the end of the century at a compound annual rate of about 3% per year. While this is only about half the long term historical growth rate, it is the same as the average growth rate for the post-oil-embargo period, 1973-1980. Unfortunately, the NEPP projection involves electricity consumption at levels far above the levels that would result if total costs were minimized.

To illustrate this point consider refrigerators. The average refrigerator in use today consumes 1740 kWh/year.[11] Robert Hoskins and Eric Hirst have shown that for an extra cost of $100 a new 16 cubic foot frost-free refrigerator could be built that consumes only 800 kWh.[12] This corresponds to a cost of saved energy of about 1 1/2¢ per kWh.[13] For comparison, the average residential electricity price in 1980 was 4.9¢/kWh, and the NEPP projects that this price will climb to 7.1¢/kWh by the turn of the century. If all refrigerators in the U.S. were replaced over the next 20 years with the most efficient unit now available*, the result for this single appliance would be an electricity savings equivalent to the output of 15 large nuclear or coal plants.[14] The potential electricity savings nationwide associated with a least-cost strategy adopted throughout the energy economy is that even with a 2 1/2 percent average annual increase in the GNP, there would be virtually no net growth in electricity demand through the end of the century, as demonstrated in the recent SERI Solar/Conservation Study (See Table 5).[3]

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* Amana will shortly market an 18 cubic foot frost-free refrigerator (model ESTR-18D) which will have an annual elecricity use of 740 kWh.

It is ironic that as we face an ever more serious fluid fuels crisis, we are simultaneously plagued with an excess of electrical generating capacity, the planned construction of some 200,000 Mw(e) of costly new generating capacity,[15,16] and a commitment in the NEPP to build even more.** And at a time when capital investments are badly needed throughout the economy -- in energy efficiency and industrial renewal generally -- we find that the electric utility is still absorbing some $40 billion dollars of capital per year for supply expansion.[16,17]

This dilemma and its resolution is nicely discussed in the recent SERI Solar/Conservation Study:[3]

> Uncertainties about future energy demands have already greatly complicated the investment strategies of the nation's gas and electric utilities. The problem is particularly difficult for electric utilities, since a decision to build a plant that will be under construction for a decade or more requires an accurate forecast of future electrical demand. Many companies have found themselves with expensive over-capacity -- the result of overestimating demands...
>
> The planning dilemma presented by these circumstances has no easy resolution. The central question is whether utilities should adjust construction programs on the assumption that cost-effective, demand-reducing investments will succeed, or whether they should assume that such investments will not play an important role and run the risk of over-investment. The thesis in this study is that the best response to such a complex problem may be to confess that public regulation is unlikely to anticipate an optimum solution, and that some move in the direction of deregulation deserves careful attention. Three approaches are examined: (1) establishing rates that send the market proper signals about the real marginal cost of supplying electricity; (2) allowing utilities to expand their investment portfolios to include some investments in energy-saving equipment on their customers' premises (with proper safeguards to prevent unfair exploitation of monopoly power); and (3) allowing

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** For the mid-range case the NEPP envisions that by the year 2000 there would be a net increase of 283,000 Mw(e) of coal and nuclear generating capacity.

Table 5. End Use Energy Demand Potentials, As Estimated in the SERI Solar/Conservation Study

(Quads* of Oil Equivalent)

Sector	1977***			2000 Potential		
	Fuel	Electric	Total	Fuel	Electric	Total
BUILDINGS	13.2	13.4	26.6	5.5	12.3	17.8
Residential	(8.8)	(7.8)	(16.2)	(3.8)	(7.1)	(10.9)
Commercial	(4.7)	(5.6)	(10.4)	(1.7)	(5.5)	(7.2)
INDUSTRY	19.8	9.3	29.1	18.7	10.7	29.4
AGRICULTURE	1.3	0.3	1.6	1.4	.3	1.7
TRANSPORTATION	19.5	—	19.5	12.6-16.5	**	12.6-16.5
Personal	(15.1)	—	(15.1)	(6.9-10.5)	**	(6.9-10.5)
Freight	(4.3)	—	(4.3)	(5.7- 6.0)	**	(5.7- 6.0)
TOTALS****	53.8	23.0	75.1	38.3-42.2	23.7	62.0-65.9

*One quad per year is approximately equal to 500,000 barrels of oil per day.

**Aggressive rail-electrification and electric-vehicle programs could create between .75 and 1.15 Quad (primary equivalent) demand for electricity in the transportation sector, with the displacement of .46-.76 Quad of petroleum (fuel) demand.

***1979 Total Consumption was roughly 79 Quad.

****Not including about 2 Quad of fuel saving possible through cogeneration

( ) = Not additive within end-use sector.

Source: Reference 3.

> nonregulated companies greater access to markets heretofore reserved to utility monopolies. (The Public Utilities Regulatory Policy Act has already deregulated many promising categories of small electric-generating technologies.) Most of these activities must occur at the state level, where utility regulation is controlled. The federal role can be limited to assistance in developing sophisticated planning tools and imaginative management of the federally regulated Federal Power Marketing Administrations.

To deal with the problem of utility overinvestment in energy supply, it is desirable to bring about institutional changes that would lead utilities to give an evenhanded treatment of investments in electrical energy supply and electric energy efficiency. A number of suggestions along these lines have been made in the SERI Solar/ Conservation Study[3] and in my testimony on July 21. Moreover, a number of "progressive" utilities have already begun innovative programs involving utility investments in energy efficiency -- including Pacific Power and Light, Pacific Gas and Electric, Northern States Power, TVA, and Arkansas Power and Light, etc.

A legitimate concern that is often raised about shifting investments away from electrical supply is that future electrical demand is highly uncertain. It is argued that while energy efficiency investments may be more cost-effective, we cannot be sure that enough investment will be made in energy efficiency to guarantee that new electrical supplies will not be needed; and since it takes 8-12 years to bring new central station plants on line, we have to begin building now to make sure that we will not be caught short a decade from now.

The response to this concern is three-fold. First, overbuilding new supplies is a terribly expensive "insurance policy." Second, the risk of underestimating demand can be greatly reduced by giving utilities incentives to aggressively pursue energy efficiency investments. And finally, a much cheaper insurance policy would involve encouraging utility investments in relatively small power plants with short lead times, such as cogeneration plants. With small, short lead-time power plants utilities would not need to plan construction 10-15 years in advance but can build a little at a time as they see how electrical demand is evolving.

A very good example of how this might work is provided by the utility-based cogeneration strategy under development by the Arkansas Power and Light Company.[18] This strategy involves the production at a centralized gasifier of medium Btu gas (derived from a variety of possible low quality feedstocks -- petroleum coke, high sulfur coal, urban refuse, industrial wastes, biomass, etc.) and the distribution of this gas via dedicated pipelines, to dispersed cogeneration units at industrial sites.* With such a system additional gasification modules, pipelines, and cogeneration units could be added to the systems as evolving electrical needs become clarified. But such forward looking utility based cogeneration strategies are inhibited by present regulations that discriminate against utility ownership of cogeneration facilities. As I pointed out in my July 21 testimony, it is desirable to make regulations regarding cogeneration neutral with regard to ownership arrangements.

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* There are many complementary benefits resulting from the strategy being developed by Arkansas Power and Light. First, gasification permits the use of the high efficiency/low capital cost gas turbine/steam turbine combined cycle cogeneration system with low quality energy feedstocks. This technology gives rise to the generation of far more electricity than is possible with conventional steam turbine cogeneration technology. As shown in Table 6, Arkansas Power and Light has already identified in Southeast Arkansas some 1700 Mw(e) of additional cogeneration capacity at 35 industrial sites. These plants could provide 2/3 as much as all the electricity generated in Arkansas in 1978.[19,20]

Another benefit is that with combined cycle cogeneration units it is possible to decouple the industrial steam load from electrical production, thereby giving the utility dispatch control over the cogeneration units.[18]

Still another important benefit is that the concept of a centralized gasifier which serves end users a clean, easy to use gas via dedicated pipelines provides a means of shifting small industrial boilers and process heaters away from dependence on oil. The NEPP correctly identifies the great problems involved in shifting these industrial end uses to coal and projects that they will still account for 1 million barrels per day of oil use in 1990.

TABLE 6a

PROSPECTIVE CUSTOMERS FOR AP&L-PRODUCED COGENERATED ENERGY (As of 1/26/81)

	CUSTOMER	LOCATION
1	ALCOA	BENTON, ARKANSAS
2	ANTHONY TIMBERLANDS, INC.	BEARDEN, ARKANSAS
3	ARKANSAS CHEMICALS INC.	EL DORADO, ARKANSAS
4	BEAR BRAND ROOFING, INC.	BEARDEN, ARKANSAS
5	BERRY PETROLEUM COMPANY	STEPHENS, ARKANSAS
6	BURLINGTON INDUSTRIES	MONTICELLO, ARKANSAS
7	CALION LUMBER COMPANY, INC.	CALION, ARKANSAS
8	COOPER INDUSTRIAL PRODUCTS	EL DORADO, ARKANSAS
9	COUNTRY PRIDE FOOD LIMITED (INC.)	EL DORADO, ARKANSAS
10	CROSS OIL & REFINERY CO. OF ARKANSAS	SMACKOVER, ARKANSAS
11	DELTIC FARM & TIMBER COMPANY, INC.	WALDO, ARKANSAS
12	THE DOW CHEMICAL COMPANY (INC.)	MAGNOLIA, ARKANSAS
13	ELK CORPORATION OF ARKANSAS	STEPHENS, ARKANSAS
14	ETHYL CORPORATION	MAGNOLIA, ARKANSAS
15	FIRESTONE COATED FABRICS COMPANY	MAGNOLIA, ARKANSAS
16	GEORGIA-PACIFIC CORPORATION, CROSSETT DIV.	CROSSETT, ARKANSAS
17	GEORGIA-PACIFIC CORPORATION, CROSSETT DIV.	EL DORADO, ARKANSAS
18	GEORGIA-PACIFIC CORPORATION HARDWOOD MILL	FORDYCE, ARKANSAS
19	GEORGIA-PACIFIC CORPORATION	STAMPS, ARKANSAS
20	GREAT LAKES CHEMICAL CORPORATION	EL DORADO, ARKANSAS
21	GREAT LAKES CHEMICAL CORPORATION	MARYSVILLE, ARKANSAS
22	INTERNATIONAL PAPER COMPANY (INC.)	CAMDEN, ARKANSAS
23	INTERNATIONAL PAPER COMPANY (INC.)	PINE BLUFF, ARKANSAS
24	MACMILLAN RING-FREE OIL COMPANY, INC.	NORPHLET, ARKANSAS
25	MANVILLE FOREST PRODUCTS CORPORATION	HUTTIG, ARKANSAS
26	MASONITE CORPORATION	WARREN, ARKANSAS
27	MONSANTO COMPANY (INC.)	EL DORADO, ARKANSAS
28	POTLATCH CORPORATION	WARREN, ARKANSAS
29	POTLATCH CORPORATION	MCGEHEE, ARKANSAS
30	POTLATCH CORPORATION	WARREN, ARKANSAS
31	REYNOLDS METALS COMPANY	BENTON, ARKANSAS
32	SUPERWOOD CORPORATION	NORTH LITTLE ROCK, ARK.
33	VELSICOL CHEMICAL CORPORATION	EL DORADO, ARKANSAS
34	WEYERHAEUSER COMPANY, PAPER MILL	PINE BLUFF, ARKANSAS
35	WILLAMETTE INDUSTRIES, INC.	EMERSON, ARKANSAS

Source: Reference 18.

TABLE 6b

INDUSTRIAL CUSTOMER REQUIREMENTS

PROCESS STEAM	PURCHASES FROM AP&L	PRESENT COGENERATION (CUSTOMER OWNED)	POTENTIAL NEW COGENERATION (ABOVE PRESENT COGENERATION) AP&L OWNED	POTENTIAL NEW COGENERATION (ABOVE PRESENT COGENERATION) CUSTOMER OWNED
PPH	KW	KW	KW	KW
1,100,000	0	80,000	290,000	0
950,000	12,060	20,000	315,000	12,000
800,000	6,760	30,000	300,000	0
375,000	8,808	20,000	100,000	0
364,000	22,599	10,000	95,800	16,200
250,000	40,067	72,000	62,500	25,000
250,000	12,774	------	62,500	8,800
240,400	1,941	------	60,000	8,000
200,000	1,274	------	50,000	7,000
200,000	6,486	------	50,000	7,000
120,000	5,344	------	30,000	3,000
100,000	1,371	------	25,000	4,000
100,000	5,252	------	25,000	4,000
100,000	6,184	------	25,000	4,000
89,000	2,936	------	22,250	2,225
80,000	5,262	------	20,000	2,000
75,000	1,917	------	18,750	1,875
70,000	2,631	------	17,500	2,000
70,000	2,984	------	17,500	1,750
70,000	1,588	------	17,500	1,750
55,000	4,113	------	13,750	1,375
50,000	2,900	------	12,500	1,250
45,000	3,644	------	11,250	1,125
45,000	844	------	11,250	1,000
35,000	5,895	------	8,750	921
35,000	1,638	------	8,750	700
35,000	3,256	------	8,750	820
28,000	2,089	------	7,000	560
25,000	2,483	------	6,250	500
22,850	461	------	5,700	457
20,000	4,240	------	5,000	455
12,000	1,961	------	3,000	290
10,000	432	------	2,500	200
9,500	562	------	2,375	190
9.500	995	------	2,370	200
6,040,250	183,751	232,000	1,713,495	120,641

Source: Reference 18.

4. Question: The responsibility for the Administration's low-income energy assistance and weatherization programs has been shifted from the Energy Department to the Departments of Housing and Urban Development and of Health and Human Services -- agencies with little conservation expertise. How well do you feel these agencies will administer these programs? Are you concerned about this?

4. Answer: The poor warrant increased attention in energy policy, because of the devastating effects of rising energy prices on low income households. As shown in analysis supporting the NEPP,[21] the percentage of disposable income spent on home fuels and gasoline by the median poverty level household would increase from 32% in 1980 to 37% in 1990 under the NEPP (compared to 11% in 1980 and 13% in 1990 for nonpoverty households).

In light of the increasing seriousness of this problem, the Administration has acted callously and irresponsibly in shifting the DOE's weatherization program to the Department of Housing and Urban Development's Community Development Block Grant (CDBG) Program.*

This is a mistake first of all because HUD has insufficient capability in this area. Even in the DOE, where such capability does exist, it took a long time to overcome start-up problems. As pointed out recently in the Energy Conservation Bulletin:[22]

> The program has been plagued over the years with management difficulties and unnecessary restrictions that severely limited its potential. However, in 1980, changes were made that turned the program around dramatically. In fact, last fall this program was weatherizing homes at the rate of 400,000 per year - twice the level anticipated by its $200 million fiscal year '81 appropriation.

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*In addition, the fuel assistance program, to be administered under the Energy and Emergency Assistance Block Grant Program by the Department of Health and Human Services, involves some fuel assistance money being used for weatherization.

The second problem with the Administration's weatherization program is that it is not a serious program. By shifting the DOE program to HUD without funding and simultaneously reducing the budget for the CDBG program by $875 million the Administration is effectively killing the weatherization program.

Congress should instead be seeking ways to substantially expand the weatherization program in an institutional context where a high degree of quality control can be achieved - with retrofits being carefully monitored to see what fuel savings are actually achieved. At an investment level of $2000 per household, some $20 billion is needed to weatherize the nation's 10 million poor households. If this program were carried out over an 8 year period it would require an annual budget of $2.5 billion, or more than 12 times the fiscal year '81 appropriation for the weatherization program. An energy tax strategy for supporting such an effort is described below.

5. Question: Under the proposed budget cuts for FY 1982, the DOE budget for conservation will be reduced by 63%. Personnel in the Office of Conservation is scheduled to reduce its staff by almost one-third by this September. In addition, major changes are occurring in several DOE conservation programs. Would you please comment on the effect that these budget and program changes might have on DOE's conservation efforts in the future?

5. Answer: The Administration has been very short-sighted in cutting back so sharply on federal energy conservation programs. These budget cutting actions go beyond a repudiation of the approach to conservation policy taken by previous administrations and make it exceedingly difficult to construct an effective alternative, market-oriented conservation policy more compatible

with the economic philosophy of the President.

As difficult as it will be, however, reconstruction of a serious energy conservation policy is necessary if the nation is to cope with the unfolding energy crisis. I hope Congress will take the initiative in the formulation of a responsible market-oriented energy conservation program -- which must involve far more government initiative than just the decontrol of oil and gas prices. As I have shown in my written July 21 testimony, the primary role of government in a market-oriented energy conservation program would be to try to eliminate market imperfections and to create an economic climate conducive to individual choice. Aside from this philosophical appeal, perhaps the most important appeal of all is that any serious plan for economic recovery must involve reducing the nation's retail energy bill. The only way this can be accomplished is to adopt a least cost energy strategy, to ensure that a significant fraction of the nation's total energy budget would be relatively low-cost "saved energy," to offset the staggering costs associated with new energy supplies. There is no other way for the nation to regain control of its energy system.

6. Question: In my view, we have to look beyond line-item budgets and programs to see what is really happening. President Reagan's decision to decontrol the price of oil indicates to me that this Administration is basically pro-conservation. How would you rate the effect of this decontrol action on conservation compared to the effect of the regulatory and other measures that were imposed by previous administrations?

6. Answer: As my July 21 testimony shows, I am sympathetic with the view that a policy aimed at making energy prices reflect the full social costs of energy production and use must be central to an effective energy conservation policy. Energy performance regulations and targetted incentives are best reserved for dealing with a limited subset of energy conserving opportunities: these policy tools can be effective in bringing about change in energy performance if directed at certain well-defined "universal" energy consuming activities (e.g., automobiles and certain energy intensive household appliances) that can be characterized by meaningful energy performance indices; and they may be necessary for certain "sticky" problems where alternative market-oriented policies are not likely to be effective (e.g., where one seeks to improve the energy efficiency of space conditioning in rental housing). But most other energy using activities require multi-purpose and changing technologies in highly diverse situations, so that detailed government intervention in decisions relating to energy efficiency is awkward at best and counter-productive at worst.

But there is much more that should be done with energy pricing policy than simply deregulating oil and gas prices. I have dealt with a number of these issues in my July 21 testimony (see the section entitled "Rationalizing the Pricing of Energy," pp. 12-15). Here I would like to follow up on one of the suggestions I made there concerning a tax on petroleum.

The NEPP projects that the world oil price will increase in real terms by 40% to nearly $50 a barrel between 1980 and 1990. This projected price increase is influenced much more by the world oil demand than by production costs. (We must not forget that the extraction cost of a barrel of Middle East oil is still only 30 cents!) As I pointed out above variations in oil demand of only a few percent relative to the present level of world oil demand spell the difference between rising and stable (or even decreasing) world oil prices.[2] The present oil glut situation shows clearly how effective oil demand reduction can be in stabilizing the world oil price. The U.S., with its high level of imports and vast potential for conservation, can have great leverage in controlling the world oil price and should be developing an energy policy with this objective. If the U.S. does not take steps to control the world oil price, a repeat of the world oil scenario following the first oil shock of 1973 may be in store for us. Just as the 12% decline (in constant dollars) in the world oil price between 1975 and 1978 spurred the 6 million barrels per day increase in "Free World" oil demand in this period and thus created the conditions for the oil shock of 1979, the present glut could once again stimulate demand and lead to yet another oil shock.

If Henry George were alive today he would understand this situation perfectly. He undoubtedly would be spearheading a political movement, not to tax away the unearned rents on land, but to tax away the unearned rent on oil. Indeed why should we let oil revenues flow to OPEC treasuries when we could otherwise prevent this drain of our dollar resources through the levy of an oil tax that is rebated or otherwise returned to the hands of our citizens?

How big would an oil tax have to be to stabilize or reduce the world oil price? The impact of an oil tax on the world oil price depends on how big the tax is and on how the revenues are used. If all the revenues were used to reduce existing taxes (say, social security taxes and corporate income taxes) or if all the revenues were rebated (say, equally among all adults), then a modest oil tax would probably lead to a modest reduction in oil demand, the burden of which Saudi Arabia could probably absorb in a production cutback that would keep the world oil price up. A large tax, on the other hand, could bring down the world oil price by creating a demand reduction, the burden of which Saudi Arabia could not absorb. As an alternative to levying a large tax, however, the U.S. could levy a modest tax and use some of the collected revenues to speed up investments in energy efficiency in areas where the potential payoff is very large. I have shown above, for example, that in just the automobile and buildings sectors, oil demand in 1990 could be about 2 1/2 million barrels per day lower than projected in the NEPP. What I would now like to show is that only a relatively small fraction of the total oil tax revenues would be required to provide powerful incentives for achieving this enormous conservation potential; most of the revenues could be used to provide a general rebate or to reduce some existing taxes.

To illustrate this point I shall sketch a scenario showing how the revenues from a general petroleum tax might be returned to the economy.* For illustrative purposes I shall assume that the tax is equal to the difference between the world oil price as projected by the NEPP and the world oil price in 1980.**

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* While I have assumed an excise tax on all petroleum, an alternative might be a tariff on imported oil, supplemented by a windfall profits tax to capture most of the induced increase in the domestic oil price.

** This tax plus the conservation measures associated with returning the revenues to the economy (complemented perhaps by additional conservation efforts in Europe and elsewhere) may be sufficient to stabilize the world oil price near the 1980 level, so that with the tax in place consumers would end up paying essentially the same oil prices as in the NEPP projection. However, a more careful analysis than that presented here is needed to estimate the impact of the tax/rebate scheme presented here on the world oil price. If the objective of public policy were to stabilize the world oil price, it would be necessary in practice to make adjustments in the level of the tax from time to time in light of experience and changing conditions to ensure that the world oil market remains "soft".

Table 7 shows that this tax would rise from $2.40 a barrel in 1982 to $13.40 a barrel in 1990. While this tax would be modest in relative terms,* it would generate substantial revenues -- some $340 billion over the period 1982 to 1990.

In Table 8 an hypothetical schedule is set forth for utilizing the petroleum tax revenues:

- The first item provides a subsidy of $2000 per household for energy efficiency investments in 2 1/2 million poor households that are heated with oil or LPG. This weatherization program would cost $630 million a year over the 8 year period, 1982 - 1990, but would account for only 1 1/2 percent of the oil tax revenues.
- The second item provides a powerful incentive to invest in energy efficiency measures in all oil or LPG heated homes. It involves offering a rebate amounting to (say) 50¢ a gallon for each gallon of oil saved, relative to oil use in the base year (1982), for up to five years after the base year. To promote careful attention to actually saving energy, it is proposed that the rebates be based on actual, weather-adjusted savings, certified by heating oil dealers or other

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*For example, the extra tax on gasoline would amount to $0.30 a gallon in 1990, when the price of gasoline (as projected by the NEPP) would be $1.67 a gallon (1980 $).

Table 7. Schedule for Proposed Petroleum Tax

	Proposed Petroleum Tax[(a)] (1980 $/barrel)	Annual Tax Revenues[(b)] (Billion 1980 $/year)	Tax as Percent of Gasoline Price[(c)]
1982	2.40	14.3	4.3
1983	3.70	20.8	6.4
1984	4.90	27.0	8.1
1985	6.10	32.7	9.7
1986	7.60	38.8	11.9
1987	9.00	44.2	13.8
1988	10.50	48.9	15.7
1989	11.90	52.9	17.4
1990	13.40	56.2	19.2
	Nine Year Total	$336 billion	

Notes

(a) The proposed tax (on all oil) is the difference between the world oil price (as projected for the NEPP) and the 1980 world oil price ($33.90/bbl).

(b) The oil demand level upon which the revenues are assessed is the NEPP projected level less the induced savings. The induced savings are taken to rise to 1.25 million barrels per day by 1985 and to 2.50 million barrels per day by 1990.

(c) Assuming the tax is reflected in the price of all petroleum products on an equivalent energy value basis, the percentage of the gasoline price represented by the tax is given by

$$100T \div (5.8\eta\ P_g), \text{ where}$$

T = crude oil tax (in $/bbl)

P_g = gasoline price, as projected for the NEPP (in $ per million Btu)

η = energy efficiency of refinery (0.9)

Table 8. Hypothetical Schedule for Utilization of Revenues for Proposed Petroleum Tax, 1982 - 1990

		Billion 1980 $	Percent
1.	Weatherization for Oil and LPG Heated Homes of the Poor(a)	5	1.5
2.	Rebates for Demonstrated Savings in Oil and LPG Heated Homes(b)	10.5	3.1
3.	Free Scorekeeping Service for Low and Moderate Income Houses(c)	1.8	0.5
4.	Tax Credits or Grants for Domestic Auto Manufacturers(d)	40.0	11.9
5.	Federal Program for Labeling Automotive Oils and Tires(e)	0.1	0.3
6.	General Rebate to Adults(f)	278.6	82.9
	TOTALS	336.0(f)	100.0

Notes

(a) A rough estimate of the population targetted for weatherization is the 2.53 million oil and LPG heated households with 1978 incomes less than $5000 (out of 18.3 million total households heated by oil and LPG). See ref. 9. An average weatherization expense of $2000 per household is assumed.

(b) It is proposed that rebates are offered for demonstrated fuel savings relative to fuel use in the base year of 1982, for up to 5 years, at a rate of 50¢ a gallon of saved fuel oil or its equivalent. It is assumed that all 16 million pre-1981 vintage oil or LPG heated households that survive till 1990 take advantage of this offer and that retrofit investments resulting in 350 gallon per year fuel savings are made at a rate of 2 million per year, 1983-1990.

(c) It is proposed that the government subsidizes scorekeeping at a rate of $25 per household per year for the period 1982-1990 for all 8 million pre-1981 vintage oil or LPG heated households that survive to 1990 and have 1978 incomes less than $15,000.

(d) It is proposed that domestic automakers be given a total subsidy of up to $40 billion over the period 1982-1990 (of the order of the amount required to retool to produce 60 mpg cars), with a tax credit or grant given for each car that is more fuel efficient than the average car being sold. The subsidy for a given car would be proportional to the expected fuel savings generated by that car relative to expected fuel use for the average car being sold.

(e) Assuming a nominal cost of $10 million per year for testing and for printing and distributing booklets to service stations, automotive parts stores, etc.

(f) This residual amount is to be rebated equally among adults. If an adult is defined as a non-institutionalized person aged 16 or over, there would be an average of 176 million adults eligible for such rebates, and the average rebate per adult would be about $1600 in the period 1982-1990.

(g) See Table 7.

"scorekeeping" firms.* Those households that exploit this opportunity and reduce their space heating bills in half (by 350 gallons per year on the average) would receive a $875 rebate, on the average. Even if all oil and LPG heated households that survive to 1990 take advantage of this opportunity and save half of their fuel, the total cost of this program would be only 3 percent of the oil tax revenues.

- The third item involves a subsidy to low and moderate income oil and LPG heated households, amounting to $25 a year to provide for free the scorekeeping services needed to monitor and certify the savings so that households could apply for the rebates described in item 2. This program would account for only 1/2 percent of the oil tax revenues.

- The fourth item provides a subsidy to domestic auto manufacturers amounting to up to $40 billion (of the order of the investment required to retool to produce 60 mpg cars). This subsidy could be in the form of a tax credit or grant given for each car that is more efficient than the average car being sold. For a given car the subsidy would be proportional to the expected lifetime fuel savings generated by that car relative to the expected fuel use by the average car being sold. While it may not be necessary to provide such a large subsidy, this analysis shows that the retooling expense need not inhibit the proposed conversion; even the full $40 billion subsidy, if necessary, would account for only 12 percent of the total oil tax revenues.

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* For a discussion of what is involved in scorekeeping, see John M. Darley, Margaret F. Fels, Miriam L. Goldberg, Michael Lavine, and Robert H. Socolow, "Scorekeeping for Retrofits," Center for Energy and Environmental Studies Report #106, August 1, 1980.

- The fifth item provides funds amounting to $10 million a year to support a federally mandated program for labeling automotive oils and tires. This program would account for 0.03 percent of total oil tax revenues.
- The sixth item is the residual, a rebate distributed equally among adults. This general rebate, amounting to about $1600 per adult, would account for 83 percent of all the oil tax revenues.

The appeal of this proposal should be obvious. It involves an innovative market-oriented (but certainly not a free market) approach to conservation in which energy prices play a central role in guiding consumer and producer choices. Both consumers and producers would be powerfully rewarded for demonstrated improvements in energy performance, thereby accelerating the formation of an effective energy conservation service industry. The program would provide an effective way to curb energy price inflation, by sustaining downward pressure on the world oil price. And finally, most of the tax revenues, which would otherwise end up in OPEC treasuries, would be available for general tax relief. (In practice a rebate to adults would be returned to most adults via reduced withholding.)

7. Question: One of the most difficult and controversial decisions that this Administration will face regarding energy will be whether to accelerate the deregulation of natural gas. Plainly, one of the benefits of accelerated decontrol will be to stimulate investment in conservation, but we must acknowledge that the rapid deregulation of natural gas could raise prices for gas customers in Illinois and other states. Could you briefly give me your views on natural gas decontrol and the advisability of accelerating deregulation in this area?

7. Answer: Because of the central role of energy price in a market-oriented energy conservation policy and because the world oil price has risen so much faster than anticipated by the framers of the Natural Gas Policy Act, I believe a speed-up of the decontrol of natural gas prices is desirable, but only if decontrol were accompanied by a windfall profits tax, the revenues of which were used to assist especially sensitive groups and to overcome obstacles to cost-justified investments in energy efficiency. Decontrol without a windfall profits tax could create a severe hardship.

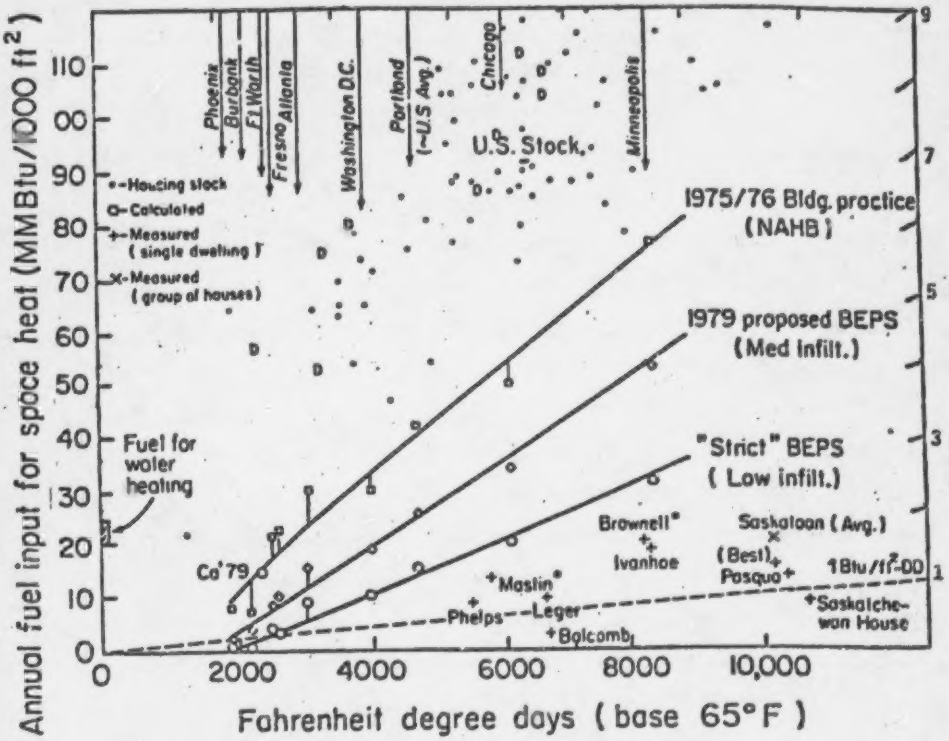
I would recommend that the windfall profits tax revenues be rebated in a manner like that proposed in Table 8 for oil tax revenues, with:

- Weatherization subsidies for poor households heated with natural gas.
- Rebates to residential gas customers for demonstrated gas savings, relative to gas use in a base year.
- A subsidy to provide free scorekeeping services for low and moderate income households.
- A tax credit to industrial natural gas customers for general investments in new plant and equipment or R&D, to compensate for the extra expenditures on natural gas associated with decontrol.
- The residual revenues rebated equally among adults.

As in the case of the oil tax, one would find that the first three programs proposed here would account for only a small fraction of the total windfall profits tax revenues, even though these three programs could be very effective in quickly bringing about a high level of energy efficiency improvement.

Notes and References

1. The NEPP numbers discussed here are from the DOE Office of Policy, Planning, and Analysis document *Energy Projections to the Year 2000, a Supplement to the National Energy Policy Plan*, DOE/PE - 0029, July 1981.
2. William L. Randol, "OPEC at a Crossroads: The May 25 Metting and Beyond," prepared by Salomon Brothers, May 21, 1981.
3. *A New Prosperity: Building a Sustainable Energy Future*, The SERI Solar/Conservation Study, Brick House Publishing, Andover, Massachusetts, 1981.
4. South Coast Technology, Inc., "Review of Improved Lubricants," in *Automotive Fuel Economy Contractor's Coordination Meeting Summary Report, April 24-26, 1978*, p. II-A-19, U.S. DOT Report No. DOT Hs-803 362.
5. TRW, Energy Systems Planning Division, *Appendix: Data Base on Automobile Energy Conservation Technology*, p. 63, Draft, Dept. 25, 1979.
6. For an existing house in an average U.S. climate the annual fuel use for space heating is about 75 million Btu per 1000 square feet of floor area. As the following figure shows the proposed BEPS and "strict" BEPS construction practices would reduce this fuel use to 25 and 15 million Btu's per year respectively, for costs of $1000 and $1500 respectively beyond the costs incurred with new house construction practice.



Annual fuel input for space heat in single-family US homes. Dots are actual gas sendout to residential customers for space heat for calendar 1978. 1979 proposed BEPS leaves infiltration at current practice levels of 0.6 air changes/hour (ach); strict BEPS reduces infiltration to 0.2 ach but restores 0.4 ach with mechanical ventilation through a heat exchanger. Approximate extra costs for conservation above 1975/76 practice: BEPS, $1000; tight BEPS - $1500; better-than-BEPS houses: several hundred to several thousand dollars. Source: A. H. Rosenfeld et al., BECA-A: Building Energy Use Compilation and Analysis, LBL 8912, submitted to Energy and Buildings, 1980.

7. The following is an illustrative list of retrofits and associated costs and fuel savings for a typical partially insulated house in Washington, D.C., having 1350 ft^2 of floor space. The house has the following pre-retrofit characteristics:

Ceiling insulation	R-11
Wall insulation	R-7
Windows	40% single glazing, 60% double glazing
Air infiltration	1 air exchange per hour
Furnace efficiency	75%
Duct Efficiency	80%
Annual Fuel Use for Space Heating	612 gallons oil equivalent

Retrofit Measure	Cost	Annual Fuel Savings (Gallons of oil equivalent)
i) Reduce air infiltration to 0.6 air exchanges per hour	240	129
ii) Add R-27 insulation to ceiling	580	101
iii) Add double storm windows to 40% of windows	560	58
iv) Seal ducts	300	29
v) Replace furnace with 90% efficient unit	400	86
TOTALS	$2080	403

Source: reference 3.

8. For the period April 1979 through March 1980 the nation's 18.0 million oil and LPG heated homes consumed 1.71 Quads of heating oil (812 gallons/household) and 0.31 Quads of LPG (see ref. 9). Taking into account 10% refinery losses this corresponds to crude oil consumption at a rate of 1.06 million barrels per day.

9. Energy Information Administration, Residential Energy Consumption Survey: 1979-1980 Consumption and Expenditures, April 1981.

10. An effective reserve for one year is defined as the reserve required to meet needs at the present (preretrofit) level of fuel use - i.e., 812 gallons per year for oil heated homes.

11. In Table iii (based on the ORNL Residential Energy Use Model) of J.L. Blue *et al.*, *Buildings Energy Use Data Book*, Editiion 2, ORNL-5552, December 1979, electricity use by residential refrigerators is given as 130 x 10^9 kwh in 1977, when there were 74.6 million households.

12. Robert A. Hoskins and Eric Hirst, "Energy and Cost Analysis of Residential Refrigerators," Oak Ridge National Laboratory Report ORNL/CON-6, January 1977.

13. The cost of saved energy is

$$C = \frac{i}{1 - (1+i)^{-T}} \times \frac{\$100}{900 \text{ kwh/year}}$$

where

i = discount rate

T = appliance lifetime

For a 10% real discount rate and a 16 year refrigerator life the cost of saved energy is 1.40¢/kwh.

14. If refrigerators in all 80 million household were replaced with the most efficient units, annual electricity savings would be

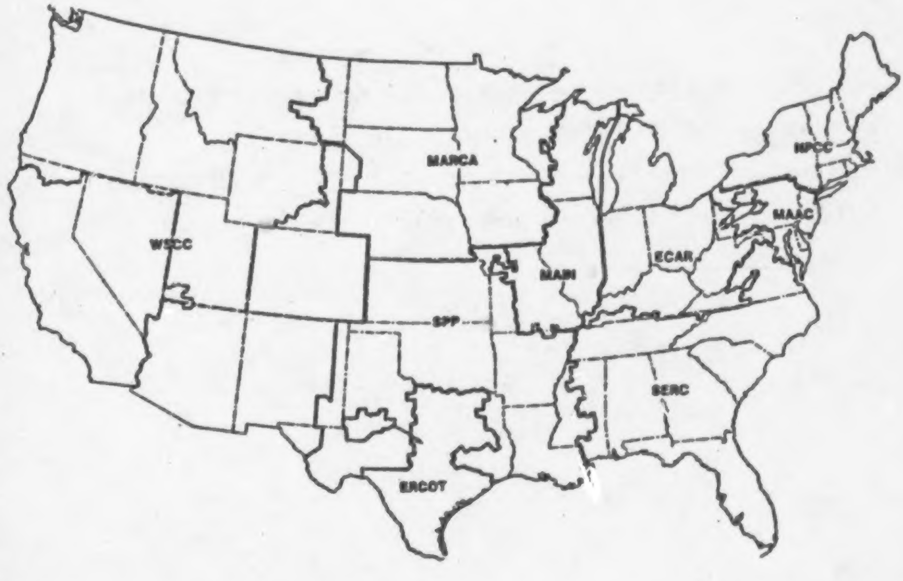
$$(1740\text{-}740) \text{ kwh/household} \times 80 \times 10^6 \text{ households} = 80 \times 10^9 \text{ kwh},$$

at the point of end use or 88 x 10^9 kwh at the point of production (allowing for transmission and distribution losses). This is equivalent to the output of 15,500 Mw(e) of baseload generating capacity, operating at an average capacity factor of 65%. It is also equivalent to 36% of the 246 x 10^9 kwh generated with oil by all power plants in the U.S. in 1980.

15. The regional breakdown of the nation's electric utility construction program, as reported in April 1981 in Electrical World (see reference 4), is as follows (in Gw(e)):

Region	Capability as of Dec. 31, 1980	Planned Additions 1981-83	Planned Additions 1984 and Beyond
Northeast Power Coordinating Council (NPCC)	52.602	0.993	8.036
Mid-Atlantic Area Council (MAAC)	49.714	4.025	9.654
East Central Area Reliability Coordinating Agreement (ECAR)	109.553	7.533	20.180
Southeastern Electric Reliability Council (SERC)	116.122	11.922	38.993
Mid-America Interpool Network (MAIN)	51.957	6.184	12.622
Southwest Power Pool (SPP)	48.863	7.360	12.215
Electric Reliability Council of Texas (ERCOT)	49.451	1.675	10.401
Mid-Continent Area Reliability Coordinating Agreement (MARCA)	27.320	3.347	3.632
Western Systems Coordinating Council (WSCC)			
Mt.		0.210	1.326
AZ/NM		1.833	5.458
CA/NV		6.987	11.864
PNW		5.019	14.481
SUB TOTAL	105.427	14.049	31.129
TOTAL Contiguous U.S.	611.011	57.287	146.862

These regions are shown in the following map:



16. Mary L. Clair, "1981 Annual Statistical Report," Electrical World, April 1981.

17. The estimated investment by the electric utility industry in 1981 is $39.3 billion. See ref. 16.

18. Wieble Alley (Manager, Energy Applications, Arkansas Power and Light), "The Use of Advanced Technologies by Electric Utilities to Expand and Extend the Use of Cogeneration," paper presented at the Center for Energy and Environmental Studies, Princeton University, June 19, 1981.

19. The potential cogeneration sites identified in Table 6 by Arkansas Power and Light all involve high load factor steam use, so that the cogeneration units would have an annual average capacity factor of the order of 80%. Thus the electricity produced by 1700 Mw(e) would be about

$$0.8 \times (1.7 \times 10^6 \text{ kw}) \times (8766 \text{ hours}) = 11.9 \times 10^9 \text{ kwh per year}$$

For comparison the total electricity generated in Arkansas was 17.7×10^9 kwh in 1978. See ref. 20.

20. Edison Electric Institute, Statistical Yearbook of the Electric Utility Industry for 1978, November 1979.

21. The Department of Energy's Office of Policy, Planning, and Analysis, Interrelationships of Energy and the Economy, a Supplement to the National Energy Policy Plan, DOE/PE-0030, July 1981.

22. See "Penalizing Success in Low-Income Weatherization," Energy Conservation Bulletin, Newsletter of the Energy Conservation Coalition, June/July 1981.

PREPARED STATEMENT OF S. DAVID FREEMAN

Mr. Chairman and Members of the Committee: I am pleased to testify before this subcommittee on a topic of such importance to the Nation. Before I begin, I should note that I am appearing here, at the subcommittee's invitation, to relate my experience in energy conservation over the past decade. I will, of course, discuss what I think we have learned at TVA in recent years, but any opinions I express should be regarded as personal and not those of TVA or the Administration.

I believe, Mr. Chairman, that nothing can contribute more to the economic well-being and national security of the United States than a comprehensive, well-thought-out and effective energy conservation strategy. As long as this Nation imports sizable quantities of petroleum out of necessity, rather than by choice, those imports will constitute a clear and present danger to our national security. Conservation represents the largest, most economical and most quickly available source of energy to reduce U.S. oil imports.

This is not just the opinion of a few energy analysts—it is a statement of fact documented by events since the energy crisis first became visible in 1973. In that year, energy consumption in the United States was growing at the rate of about 3½ percent annually. If that growth had continued—as most experts projected it would—total energy consumption would have increased more than 25 percent by 1980. That would have required the equivalent of an additional 10 million barrels of oil per day in energy supplies.

But it didn't happen that way. Total U.S. energy consumption in 1980 was only 2 percent higher than in 1973, even though real GNP increased by 20 percent in the same period. Put another way, energy use per dollar of economic output was reduced by 13 percent. Oil imports did continue to climb and reached an all-time high of 8.8 million barrels per day in 1977, but conservation has finally turned the corner and reduced them to approximately the 1973 level of about 6 million barrels per day. The period since the embargo has conclusively demonstrated that the GNP can grow much faster than energy use—that we can achieve increased efficiency in the use of energy, saving millions of barrels of oil each day and billions of dollars each year.

The post-embargo period has also demonstrated how inflationary and how hopeless is the idea of relying primarily on increased oil production to reduce imports. Crude oil prices have gone up 1,000 percent since 1973, from about $3 a barrel to over $30. But production of crude oil in the U.S. has dropped 7 percent, from 9.2 to 8.6 million barrels per day, and that includes 1.6 million barrels of daily output from the north slope in Alaska. And although the petroleum industry reported investments of nearly $25 billion in domestic oil production in 1979, and expects to report still higher investment for 1980, the general outlook is that the best that can be expected is a stabilization of current domestic production levels.

Investments in energy production have been plagued by runaway inflation and longer and longer lead times. These investments in turn have been a principal cause inflation in our economy. Investments in energy conservation, by contrast, have reduced energy needs at costs ranging from almost nothing to less than half the cost of equivalent conventional production. And for the most part, only conservation investments that are virtually free or promise to earn the consumer at least 25 percent on his money have been made to date.

I stress the economics of energy conservation because I am fearful we may be overlooking the powerful anti-inflationary benefits of increased conservation investments. Inflation is still the number one curse of our economy, and energy prices have been a major culprit in feeding the inflationary spiral. Getting two or three times as much energy out of each of the billions invested in domestic energy production can make the critical difference in bringing inflation down to a level that is tolerable. And each additional barrel of oil consumed not only costs the U.S. economy more than twice as much as saving it, but adds to our dependence on the volatile Middle East, and thus adds to the risk of another world war.

The fact that Americans have begun to conserve energy just as energy prices have surged upward suggests, of course, that market forces will encourage prudent consumers to increase their investments in energy conserving devices. If the security and economic and environmental well-being of this nation were not at stake, we could afford to be indifferent to whether consumers use more or less energy. But I don't think the Nation can afford to be indifferent. The more energy we consume, the more dependent we become on imported oil, the more we degrade the environment, and the more we inflate the economy. So I believe it is useful to explore what could be done to promote greater efficiency in the American people's consumption of energy.

As it is, market forces are heavily tilted in favor of energy production and against conservation. This production bias persists even though any businessman in a free market with a choice of whether to invest in production or conservation would clearly opt for conservation. But few businessmen enjoy such a choice. The production organizations have access to capital on terms that would be the envy of the average energy consumer. Investments in electric power plants, coal mines, and petroleum production are traditionally made in large amounts, in the expectation of a long-term payout. And these organizations are not in the business of conserving energy. The oil companies now talk about conserving, but they are in the business of selling petroleum. As for the utilities, they until very recently were forbidden to invest in energy conserving equipment for their consumers, even though it has been in their economic interest to do so for the better part of a decade.

The market bias against conservation is even more pronounced on the consuming end. The average homeowner or business person is not in the energy conserving business at all and, at a time when interest rates are relatively high, is reluctant to invest in anything that will not pay for itself in less than five years. Thus, we are presented with the anomaly of tens of billions of dollars going into finding more petroleum and paying for imported oil when these same dollars could be saving from two to five times as much petroleum if invested in energy saving technology ranging from installation of home insulation to the development of a 60-mile-per-gallon automobile. Insulating an average home under TVA's home insulation program, for example, saves an estimated 4,300 kilowatt hours annually. That is the energy equivalent of about 8 barrels of oil, at a cost of about $15 per barrel. Duplicating those savings in even half the homes of the Tennessee Valley would produce a very cost-effective reduction in energy consumption equivalent to 10 million barrels of petroleum every year.

Shortages, higher prices, and legislation such as mandatory fuel economy standards for automobiles have indeed prompted Americans to start conserving energy. But, as I have indicated, we have only begun to cash in on opportunities to reduce the energy waste in our economy and our way of life. The role of public policy, then, should be to encourage consumers to make additional energy conserving investments because, on the margin, a barrel of oil equivalent saved is a barrel we do not need to import. In my view, three elements are essential to a workable national energy conservation strategy.

First, and most fundamentally, we need to encourage the development of a conservation ethic among the American people. Opinion leaders throughout the Nation need to understand that energy conservation is vital to the nation's well-being, that we live on a planet of limited resources and that using resources frugally must therefore become our way of life. This doesn't mean doing without at all, it means that improved efficiency can squeeze more useful work out of very expensive and fairly limited resources.

This commonsense understanding of conservation lends itself to equally commonsense application. Citizens can and should be encouraged to do less joyriding, spending more time at home and less on the road, and to become more energy conscious in purchasing homes and automobiles. Recent initiatives to promote commercial investments in energy conservation require encouragement, because for most establishments the real cost of energy is still not a large enough item to attract the attention that the national interest requires.

The conversation ethic needs encouragement on grounds of individual self-interest and the interests of future generations, and also because of the overwhelming national interest in becoming more energy self-sufficient. We have made some progress in recognizing the fundamental nature of the energy problem, but a much more sustained and concentrated educational effort is needed. This hearing constitutes a very valuable step in that process.

I stress the role of opinion leaders because I believe that American consumers have not forgotten the gasoline shortages. And they also know there is a large environmental price tag on all energy production. People can and will respond to more than just the price of gasoline. The fear of shortages can be an even stronger incentive. Leaders can play a crucial role in reminding the public that we are joyriding on foreign oil, at our daily peril.

A second element in a sensible national conservation strategy would be to provide sufficient financial incentives to encourage a more rational balance of investments in the marketplace between conservation and production. Toward that end, the TVA experience suggests that three steps are required.

First, the consumer must be given detailed information. Based on a professional audit of his building or commercial establishment, revealing what savings are possible and at what cost. Except for the larger, more energy intensive companies, we found that most consumers will not make even the small initial investment required to determine what energy conservation opportunities exist. But TVA and the distributors of TVA power now have more than 450 people in the field providing energy audits, and as a result, more than 365,000 audits have been completed and more than 180,000 homes and a growing number of commercial establishments have responded with energy conserving investments. In our judgment, most of these investments would not have taken place without this effort.

But for most consumers, even having a precise audit listing potential savings is not enough. TVA has found that for residential customers, having access to front-end money on reasonable terms, with repayments as part of their electric bills, has been a key incentive. More than $155 million has been advanced in this manner. A similar loan program for industrial customers is now being initiated. These programs accounted for the bulk of the 700 million kilowatt-hours and $22 million TVA calculates its customers have saved through conservation in 1980.

Even more useful would be large tax credits that would bring the payout period for investments in conservation down to a level that would attract additional investments. A large number of conservation measures involve a 5–10 year payout.

These measures are far more economical than using imported oil, but they are not being made because the oil companies aren't in the conservation business, and businessmen have better investments for their money at today's interest rates. That would change with the incentive of additional tax credits, tax credits that would be fully justified through national security benefits alone.

A third element in a workable national energy conservation strategy would be promotion of investments in research and development of new energy conserving technologies. It is remarkable that we have achieved as much conservation as we have to date simply on the basis of conservation devices that are already commercially available. Yet it is undisputed among the experts in the field that we are achieving only a very small percentage of potential savings in energy. If we considered, as we should, that energy conservation is a source of energy supply like coal or nuclear power, then investments in developing the 60 MPG automobile, much more fuel efficient houses, more efficient electric motors, heat pumps, and a whole host of other energy conserving equipment would move to the top of our list of energy R&D priorities.

These technologies are decentralized, and their development is very properly in the hands of private industry. There is no need for a massive governmental effort in this area, but there is every reason to provide a large tax credit of 50 percent or more for investments in energy conservation research and development that have the potential for tremendous payoffs to society as a whole. Private companies simply won't take the risk without such a cost-sharing approach. A program of this sort could spur an acceleration of fuel-efficiency in the economy in the 1980's that could be more cost-effective than any other energy investment.

The automobile industry of course represents the most dramatic example. Making the American people a 50/50 partner with the American automobile industry in quickly developing a 60 MPG automobile may be the best means of putting Detroit back into a competitive position in the face of the challenge from foreign automakers who have already learned that efficiency can pay handsome returns.

I think the program I have outlined includes the essential elements that will be required to keep this nation on the road to energy self-sufficiency. Certainly, TVA's experience in the last four years has been that education, financial incentives and state-of-the-art conservation technology can all play a vital role as part of an overall effort to promote intelligent energy use. When adequately planned and effectively administered, such a program can accelerate the elimination of energy waste to a far greater rate than the marketplace alone could achieve.

Conservation should be particularly attractive to electric utilities because it provides a means of forestalling the need for additional generating capacity that they find themselves unable to finance at today's interest rates. Some opponents of the idea that utilities should provide front-end financing and zero- or low-interest loans mistakenly view such programs as mere subsidies. These critics fail to recognize the overall benefits conservation and renewable energy programs can offer both utilities and their customers by reducing the need to build new plants.

For the TVA power system, for example, the benefits of conservation clearly outweigh the costs. By 1990, we expect our conservation efforts to be saving more than 7 billion kilowatt hours annually, and we expect them to reduce generating capacity requirements by more than 3,500 megawatts. The program's estimated cost of $800 million through 1990 compares quite favorably with the $7–9 billion system costs TVA would otherwise be forced to incur to meet peak load requirements.

I do not mean to leave the impression that the TVA conservation program has simply sprung up overnight, as if in response to a wave of a magic wand. We have been on a very steep learning curve over the last four years, a curve that has demonstrated how much easier it is to talk about conservation and other kinds of decentralized energy than it is to implement them. Even the best information and months of careful planning cannot eliminate the possibility of failures and unexpected problems. And not all conservation and decentralized energy programs will cost as little or displace as much energy as initially projected.

Promoting conservation is an enormous management and marketing challenge. Unlike the centralized and highly structured task of building a new power plant, these programs involve keeping track of and using effectively numerous elements of labor, money and materials in thousands of geographically dispersed locations. To run such programs requires that a utility devote some of its best talent to the effort. Simply expanding the traditional customer relations department won't get the job done.

TVA has recognized the importance of its efforts to influence future demand by dividing the agency's Office of Power into two clearly differentiated parts, one devoted to energy production and one devoted to energy use. On the use side, we have established two separate divisions, one assigned to promoting energy conservation and renewable energy and one to maintaining an effective working relationship with our 160 municipal nad cooperative power distributors, who are responsible for implementing conservation programs.

TVA has, in other words, created the organizational framework that will be required to meet the challenge of maintaining a balanced energy supply system. This system will inevitably include some additional generating capacity to meet the needs of a growing economy, but TVA is committed to getting the most out of its investment by improving the efficiency with which energy is used. We believe other power producers would do well to do the same.

I would like to close, Mr. Chairman, by returning to the subject of the change in attitudes that must occur if we are to achieve a truly durable society. The key to reaching this goal, it seems to me, is a whole new set of expectations on the part of the American people. I believe it is the key to their future happiness and, in a sense, the key to America's future survival and prosperity.

There is simply no disputing that we are in a new era, not only with regard to energy but with regard to many of our most vital natural resources. And unless we adjust our expectations and our concept of happiness to this new era, we are quite simply doomed to frustration, disappointment and a feeling of failure. Adjusting to a new era doesn't mean going back to the caves or to a life of drudgery. It simply means using the resources we have sparingly and intelligently. The conservation ethic also means elevating human values and downgrading our expectations for super-affluence in material goods. For a nation founded on Puritan principles of thrift and efficiency, this amounts to nothing more than getting back to our roots.

But if we are to make the transition successfully, we must begin immediately, and that means getting the utmost out of one of our most critical natural resources, energy. I firmly believe that a comprehensive national energy conservation strategy along the lines I have outlined is the most practical means of achieving that end. We at TVA would be glad to play whatever role we can in the execution of such a strategy for the 1980's.

MR. FREEMAN'S RESPONSES TO WRITTEN QUESTIONS SUBMITTED BY SENATOR PERCY

Question 1. The Reagan Administration's National Energy Policy Plan asserts that "achieving a low level of U.S. oil imports at any cost is not a major criterion for the Nation's energy security and economic health." Could each of you please comment on this statement and its implications for conservation policy?

Answer. I believe the explanation by the Administration witnesses at the hearing put the above quoted statement in the proper context and made clear that import reduction is a high priority goal of energy policy. Of course the statement is literally true. No one would suggest lowering U.S. oil imports "at any cost."

Question 2. As I mentioned earlier in my questioning of Mr. Tribble, the National Energy Plan projects net oil imports to be at 6 to 7 million barrels per day in 1985 and 4 to 5 million barrels per day in 1990. Do you agree with these projections? Do you think we would be doing well as a Nation if we were still importing that much oil in those years?

Answer. Projections contain a large element of self-fulfilling prophecy. I, of course, have no basis for agreeing or disagreeeing with these projections except I believe that the national interest would be far better served by a target of reducing imports and increasing oil stockpiles so that imports are down to a level that reflects our choice rather than our dependence. Certainly the current share of our total energy supply held by imports and the size of our stockpile must give pause to those concerned about security, economic health, and the flexibility with which we carry out our foreign policy.

Question 3. The National Energy Policy Plan indicates that there will be a need to increase the electrical generating capacity of power plants, while making no mention of the alternative of investing in cogeneration, load-leveling, or other conservation technologies in the utility sector. Will each of you please comment on the degree to which conservation could offset the need for new generating capacity and outline for us which conservation measures you find most promising?

Answer. It can be very misleading to examine only national averages when assessing future electrical needs of the Nation. It is important to distinguish between regions that are growing rapidly and those that are not and also between regions that presently rely on petroleum as power plant fuel and those that do not. TVA is projecting the equivalent of 6,000 MW of new capacity from conservation and cogeneration yet we also are building substantial additional capacity. The Tennessee Valley, of course, is an area that is experiencing healthy economic growth which we expect to continue. Other parts of the Nation may not grow as rapidly and their needs could well be satisfied more completely with the alternate energy sources you mention.

The picture that emerges is one in which we can and should supply more of our future needs through conservation and decentralized energy sources. But, at the same time we need to be building more central station plants to replace petroleum-fired capacity and to provide electrical energy needed to sustain growth beyond that derived from conservation and decentralized sources.

The conservation measures which we have found most effective are improving the weatherization characteristics of existing residential dwellings, improving the energy utilization of existing industrial and commercial facilities, and encouragement of energy efficient design in all types of new construction.

Question 4. The responsibility for the Administration's low-income energy assistance and weatherization programs has been shifted from the Energy Department to the Department of Health and Human Services—an agency with little conservation expertise. How well do you feel these agencies will administer these programs? Are you concerned about this?

Answer. I have no reason to believe that the Department of Health and Human Services, in cooperation with the Department of Energy, does not have the capability to administer low-income energy assistance and weatherization programs.

Question 5. Under the proposed budget cuts for fiscal year 1982, the DOE budget for conservation will be reduced by 63 percent. Personnel in the Office of Conservation is scheduled to reduce its staff by almost one-third by this September. In addition, major changes are occurring in several DOE conservation programs. Would you please comment on the effect that these budget and program changes might have on DOE's conservation efforts in the future?

Answer. I am really not close enough to DOE's conservation efforts to venture an opinion on the impact of their budget cuts. At TVA we believe that conservation is cost effective but it does require tailor-made consumer information and front-end financing assistance. These are basic ingredients of TVA's program. It would be in the public interest for the utilities throughout the Nation bringing natural gas and electricity to their customers to emulate such efforts.

Question 6. In my view, we have to look beyond line-item budgets and programs to see what is really happening. President Reagan's decision to decontrol the price of oil indicates to me that this Administration is basically proconservation. How would you rate the effect of this decontrol action on conservation compared to the effect of the regulatory and other measures that were imposed by previous administrations?

Answer. It is difficult to separate the effects of conservation achieved by higher prices from that achieved by regulations and other affirmative measures. TVA's experience suggests that the two types of actions are complementary. We have found that bringing information directly to the consumers, providing front-end money, and increases in energy prices all contribute to conservation. Without these measures, our experience indicates that there are lower levels of conservation among residential customers. In spite of the effectiveness of price for inducing conservation, it is also important to weigh its impact on inflation and on lower income consumers when evaluating the decontrol option.

Question 7. Panelists, I have one last question. One of the most difficult and controversial decisions that this Administration will face regarding energy will be whether to accelerate the deregulation of natural gas. Plainly, one of the benefits of accelerated decontrol wil be to stimulate investment in conservation, but we must acknowledge that the rapid deregulation of natural gas could raise prices for gas customers in Illinois and other States. Could you briefly give me your views on natural gas decontrol and the advisability of accelerating deregulation in this area?

Answer. I am not following this issue closely any longer but the situation with natural gas appears generally analogous to what has occurred with electricity. Higher prices clearly provide incentives for greater conservation. In addition, TVA's experience suggests that if a program of tailor-made information and front-end money were made available to the residential and small commercial users of natural gas, as much or perhaps more conservation would be achieved at a far lower cost to the economy. These affirmative efforts also help consumers decide what is the most cost-effective way to meet their energy needs without experiencing the economic shock that could accompany immediate decontrol of natural gas.

Senator PERCY. The hearing is adjourned.

[Whereupon, at 11:30 a.m., the subcommittee was recessed, to reconvene subject to the call of the Chair.]

ADDITIONAL MATERIAL SUBMITTED FOR THE RECORD

LBL 12739
EEB 81-2

ACCELERATING THE BUILDINGS SECTOR'S SLUGGISH RESPONSE TO RISING ENERGY PRICES

by Federal R&D, Information, and Analysis Programs.

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Testimony
before the
Interior Appropriations Committee
U.S. House of Representatives
Washington, D.C. 20515

April 8, 1981

CONTENTS

I. Introduction 2

II. Overview 2

III. Categories of Programs that Merit Support 3
    A. Research on Building Science, Indoor Environment and Health 3
        Example: Indoor Air Quality 4
    B. Programs which accelerate market response 9
        Analysis of Market Lag in Energy Efficiency Investment 9
        B1. Labels for Cars, Appliances, Homes, and Buildings 15
            Example: PG&E's Energy Labels for New Homes 16
        B2. R&D that cannot be patented or captured 21
            Example: Fan Pressurization 22
        B3. Near-term technology development when 23
            a. There is no organized US industry 23
                Example: Residential Heat Exchangers 24
            b. Industrial inertia hampers innovation . . . . (23)
                Example: High-frequency Ballasts for Fluorescent Lamps . 25

Appendix A. "Improving Energy Efficiency" The Case for Government Action" Table of Contents of the paper by Hirst, Fulkerson, Carlsmith, and Wilbanks of Oak Ridge National Laboratory 28

Appendix B. Sample Score Sheet for PG&E Energy Efficient Home Labels 29

Abstract

The response of the buildings sector to the recent rapid rise in the price of energy has been perceptible but very slow. A history of low energy prices has left the US with a stock of buildings which use far more energy than a least-cost building stock would. With energy costs continuing to rise much faster than general inflation, this delay in market response costs households and consumers billions of dollars each year. The difference between actual and optimal strategies may be measured either by an implicit consumer discount rate, or by the number of years it might take for the market to reach today's cost-minimizing level of energy efficiency. Currently, the consumer discount rate is between 15% and 40% in real dollars instead of the 2.7% which mortgage rates averaged between 1963 and 1981. We take this 2.7% to be the value of the consumer discount rate for home improvements when adequate trustworthy information is available. The market lag is between 15 and 30 years. We discuss ways of speeding the market's response to higher energy costs for the buildings sector with special reference to the role of the federal government.

Federal support is indicated in two main areas: (1) programs to alleviate possible public health and welfare effects, (2) programs to speed the day when the market's performance is closer to optimal. The first area includes research programs such as indoor air quality. Reducing the leakage of heated or cooled air from buildings can save half a million barrels a day of oil equivalent (approximately one quad per year), but may have undesired health effects. Indeed, research has shown that for certain indoor air pollutants, health effects may already be occurring in today's poorly sealed buildings. Research on this topic can help ensure that "leak plugging" in homes and commercial buildings will not affect public health, but it is precisely this type of R&D that is least likely to be supported by private industry.

The second area calling for government involvement to reduce market lag industry includes testing and labelling homes for their energy consumption; development of essential diagnostic equipment that would be difficult to patent (such as the Princeton/LBL blower door); and short-term technology development in areas where there is currently no US manufacturer (such as the air-to-air heat exchanger) or where inertia needs a small push to get it moving (such as electronic fluorescent ballasts). Details of all these examples are given, with costs and expected savings.

We conclude that there is a potential to save $50 billion annually by improved energy efficiency in buildings, and that federal programs costing a few million dollars each year could advance the date of there saving by several years.

April 7, 1981

I. INTRODUCTION

This paper is written in response to the Reagan Administration's FY 82 budget cuts, in which the Department of Energy's Office of Buildings and Community Systems program is reduced to less than one-third of Carter's FY 81 budgets In our judgment, these cuts will drastically reduce the research activities on energy efficiency in buildings. The immediate effects of the cuts will be to halt a multitude of valuable and important research activities. However, it will not be long before the effects will extend well beyond the research community. In the absence of essential research, information, and analysis programs on energy efficiency in buildings, much of the progress that the market has made in improving the efficiency of energy use in buildings will be slowed, to the detriment of all.

It is our thesis that there are several areas of research, and related activities, on building energy efficiency in which the federal government has a critical role. These areas include:

- o Research in building science to advance the state of knowledge and to solve social problems (eg., indoor health effects).
- o Programs to accelerate market acceptance of cost effective investment in energy efficiency, including:
  - -- energy efficiency labeling programs;
  - -- research and development that is unlikely to be undertaken by the private sector because it cannot be patented;
  - -- near-term technology development that the private sector is not organized to undertake, in spite of potentially large payoff.
- o Government information programs for forecasting, planning, and analysis, so that the government has sufficient information to make informed decisions.

II. OVERVIEW

We agree with an important element of the Reagan Administration -- deregulation of oil as gas as soon as possible, and letting the market respond as fast as it can.

But we argue that market response in the buildings sector will take about 20 years unless the Federal Government takes some limited but critically important leadership role to accelerate market response.

Our annual energy bill is now over $1 billion/day ($400 billion per year), and one third of it goes to the buildings sector. Market response will eventually save about 1/3 of that, or nearly $50 billion/year in buildings. So every year that we can advance that response, we save tens of billions of dollars.

April 7, 1981

Moreover, the eventual resource energy savings in the buildings sector alone are comparable with our oil imports for all sectors. Can we then afford to hold our energy economy and our foreign policy hostage to its own built-in inefficiencies any longer than necessary?

In cars and appliances, as we shall see below, there is a lag of about ten years between energy price increases and the market's response of maximum efficiency. In buildings, this lag is much longer, 10 to 20 or more years. In the time scale of oil supply -- where there are wars, revolution, and instabilities every few years -- a potential maximum efficiency advance of ten years is indeed a significant help towards reaching energy stability.

If there is a case to be made anywhere in the U.S. economy for government actions to accelerate market response to rapidly changing prices, surely that case can be made most validly for building energy use.

III. CATEGORIES OF PROGRAMS THAT MERIT SUPPORT

In this main section of our paper we present 5 categories of Federal programs which reduce the life-cycle cost of buildings (without compromising their amenities) and improve indoor air quality, thus decreasing the present death rate from breathing radon daughters and other indoor pollutants (see the Box on Indoor Air Quality). Yet Federal programs in all five of these areas are being drastically cut. We shall show that this is unwise.

Before proceeding through our categories and examples, we should mention a current report by Hirst *et. al.*,[1] of Oak Ridge National Laboratory. They address these issues for all end-use sectors, while we confine our remarks to buildings. Hirst et. al. give 15 examples of cost-effective programs, in the form of 1-page exhibits. We reproduce at the back of this report a table of contents of Oak Ridge paper, to encourage the interested reader to obtain this paper.

CATEGORY A. RESEARCH ON BUILDING SCIENCE, INDOOR ENVIRONMENT AND HEALTH EFFECTS.

This is an area which is clearly the responsibility of the public rather than the private sector. Exhibit 1 describes the Ventilation and Indoor Air Quality program at Lawrence Berkeley Laboratory.

We also introduce Figure 1 to show that we have developed and tested hardware both to detect radon gas and control it effectively. Figure 1 shows the concentration of radon in a home in Mt. Airy, Maryland. The measurements cover two weeks. The non-scientific reader can best interpret the vertical scale by using the course rule of thumb that one unit corresponds in lung-cancer risk roughly to smoking one cigarette a day (which doesn't bother most of us), so that the maximum of 30 units corresponds to every man, woman and child in the home smoking 30 cigarettes a day (which is, a much more serious matter).

Example 1

INDOOR AIR QUALITY

In the United States, the natural infiltration of outdoor air causes, on the average, a complete exchange about every 1.5 hours of the 1,000 lbs. of air in the typical house. This is called 2/3 "ach" (air changes/hour). This natural exchange dilutes the indoor pollutants: combustion products, organics outgassing from particle board and furnishings, radon outgassing from soil and building materials, odors, water vapors, etc.

In 1975, in Sweden, a new building code, SBN 75, was passed with the intention of limiting natural infiltration in Swedish homes to 0.2 ach. Additional ventilation, to supply a total of 1/2 ach, was provided by mechanical means. This program was delayed because of problems with indoor air quality. Measurements (some of which could have been made before the code was written) showed that even the accepted 0.5 ach was inadequate for some homes. By inadequate we mean that at 0.5 ach (in Swedish homes) pollutants might build up to undesirable levels. Two pollutants of concern in Sweden and in the U.S. are radon and formaldehyde. Radon is a radioactive gas which breaks down into substances which increase the risk of suffering lung cancer. Formaldehyde is an irritant organic chemical.

LBL has also measured the radon gas in many homes. Exposures of the entire population, even to typically measured indoor concentrations, may cause 2000-20,000 lung cancers in the United States per year. Even more serious is the risk experienced by the several percent of the homes that have much higher concentrations. These would require special control measures.

One possible control measure is the supply of additional ventilation air using an air-to-air heat exchanger. In Europe and Japan there is a well established residential heat-exchanger industry. In California, LBL has set up a heat exchanger testing facility and has tested many foreign units. Only in 1980 did the first U.S. potential manufacturer present a prototype for testing.

In the United States in 1979, LBL made measurements of organic pollutants in one new home, equipped with new furniture, and found formaldehyde at levels which could cause discomfort to occupants. We do not yet know how long it takes for this formaldehyde level to subside, nor have we yet received funds to set up a laboratory to follow outgassing.

Because of the ignorance about indoor air quality and its cures, home-owners are understandably worried about tightening their homes, and builders are concerned about building tight new homes.

Even if we callously ignore the health effects of indoor pollution, we can consider its economic impact. Not until we understand the problem, can we confidently reduce infiltration. Reducing infiltration by 1/4 ach would mean an annual fuel saving of 100 therms of gas or 75 gallons of oil. Nationwide (including electrically-heated homes and air conditioning), this translates into 0.8 quads of resource energy, costing $5 billion/year. Yet DOE spends only $2 million/year on general indoor air quality research. EPA spends more, but only on special problems like the Love Canal.

To pay for itself, then, the present tiny indoor air quality program only has to advance by 4 hours the happy day when we can confidently tighten our homes.

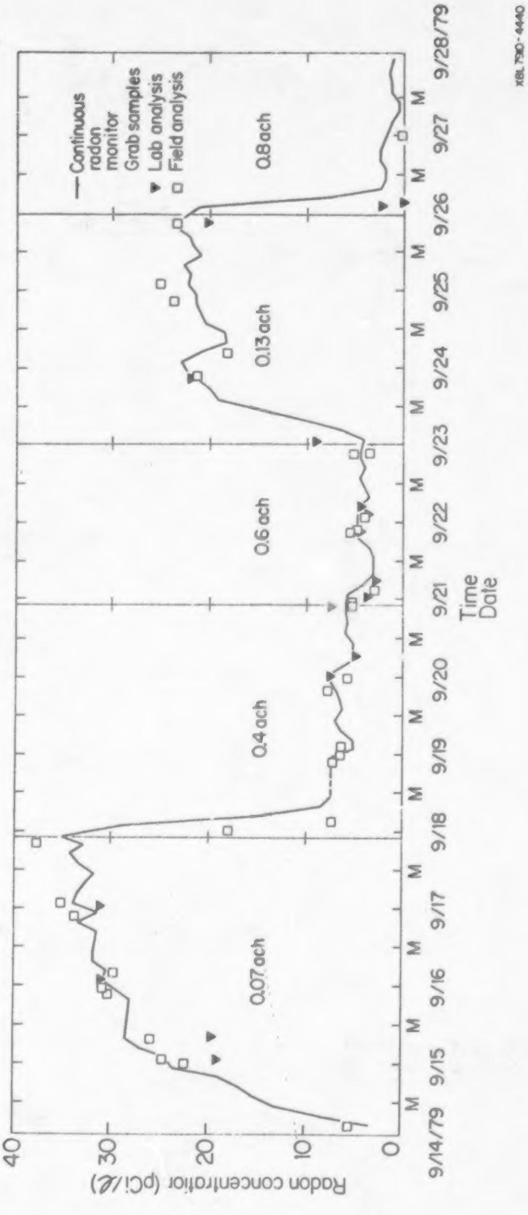
The home was aired out, and then the windows were closed as the experiment began. We see the radon build up over about one day, and level off at about 30 (cigarettes/day) until an air-to-air heat exchanger was turned on. The level promptly dropped to 5 (cigarettes/day) for a few days. Then the mechanical-ventilation / heat-exchanger was turned off and the radon rose again. This time the natural infiltration rate was higher (it was windier or colder) and the radon level rose only to 20 (a pack a day). Finally heat exchanger was turned to a higher setting and reduced the radon to safe levels. These heat exchangers retail for $250 for window unit to $500 for a central unit, and demand only 50-150 watts of electric power.

If the radon level in this energy-efficient home dropped only to 5 at 0.5 ach, it seemed likely that there was a high concentration of radon in the soil gas in the neighborhood, and that conventional, leaky, homes should be measured also. LBL wrote a contract with Geomet to survey 59 homes, and their report[2] confirms our suspicions. Four of the homes have radon levels of over 10 on the main floor (two are 25); one basement of a conventional home measured 67. On the basis of this spotty evidence, and similar results in Pennsylvania, we worry that perhaps one percent of the homes (with over 2 million occupants) in the US may have radon levels above ten, where remedial action would be indicated.

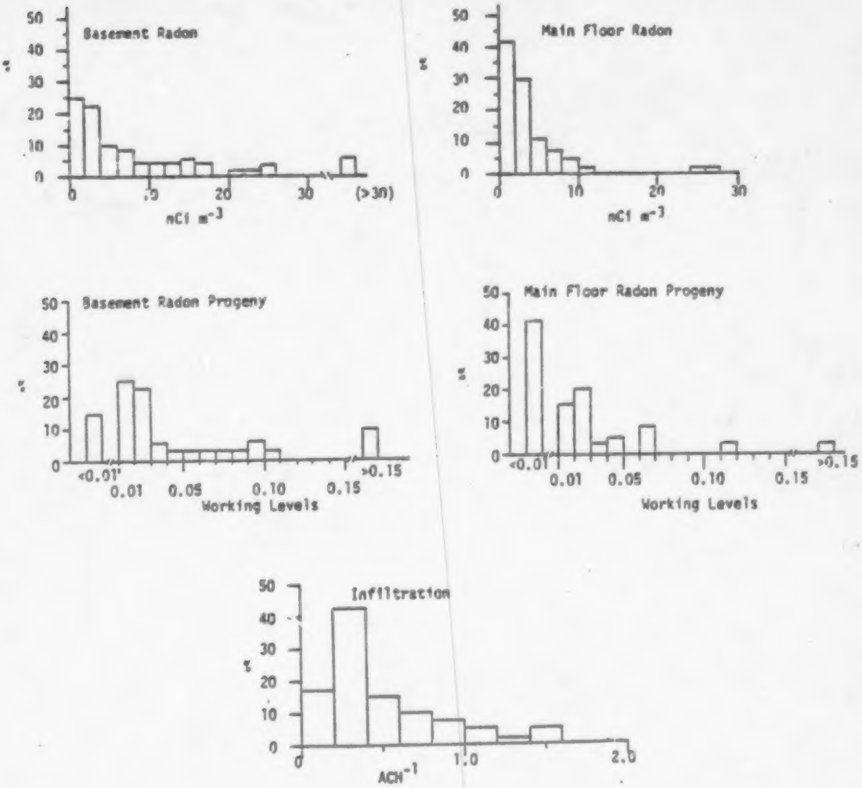
Finally, to convey the importance of this new field of indoor air quality, opened up by DOE-sponsored research, we show a gas chromatographic spectrum of indoor pollutants sampled in new office space at LBL, compared with the air outdoors. Each of the indoor peaks represents a separate organic compound which needs investigation, and perhaps control measures.

Fig. 1 INDOOR RADON CONCENTRATION

Energy Research House
With Mechanical Ventilation
Carroll County, Maryland



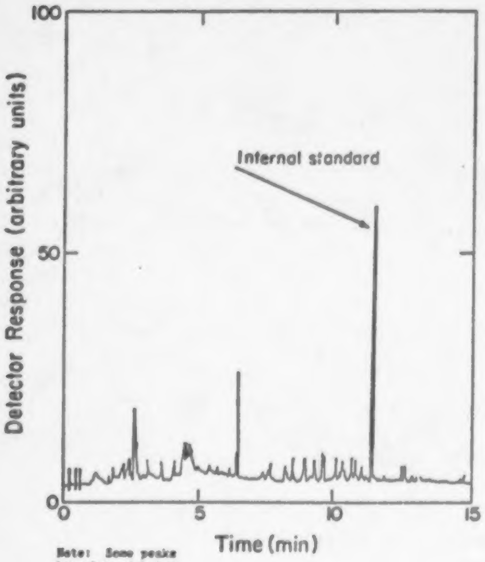
59 Homes in Mt. Airy, Md., surveyed by GEOMET for LBL.
GEOMET Report ES-877, Jan. 14, 1981



Note by A. H. Rosenfeld: on the top two histograms, the unit of 1 nCi/m^3 is the same as the 1 pCi/l in Figure 1, and is roughly equivalent in lung cancer risk to one cigarette per day; 20 is about a pack a day

Figure 1a. Frequency distributions of radon concentrations and working levels of Rn progeny (basement, main floor) and infiltration for all homes in survey.

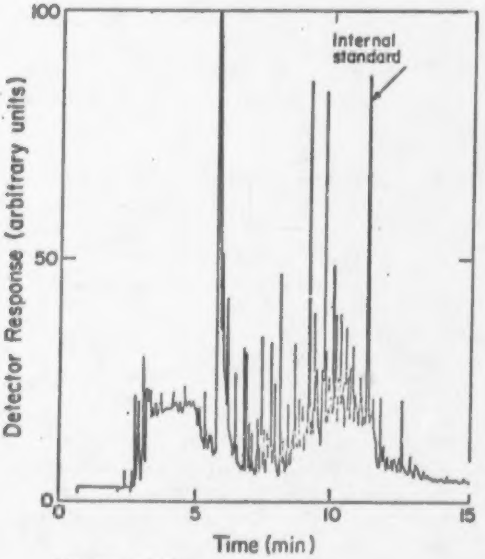
TENAX ORGANIC SAMPLE
Outdoor Air



Note: Some peaks have been deleted to improve clarity.

Figure 2:
A COMPARISON OF THE ORGANIC CHEMICALS FOUND IN INDOOR AND OUTDOOR AIR, AS DETECTED BY THE GAS CHROMATOGRAPH.

TENAX ORGANIC SAMPLE
Indoor Air



Note: Some peaks have been deleted to improve clarity

April 7, 1981

CATEGORY B. PROGRAMS THAT ACCELERATE MARKET RESPONSE

Market Lag in Energy Efficiency Investments

One of the most critical issues to the assessment of the federal role in energy conservation is the evaluation of what the market is likely to do without government involvement. We have sought answers to the following questions:

- What has been the historical response of the market to rising energy prices and to an increasing awareness of potential U.S. energy problems?
- What is an economically sound and socially desirable market response in the building sector to current and projected energy prices?
- How can one quantitatively evaluate the degree to which the market lags behind the desirable market response?
- If the market is lagging or unresponsive, what are the key factors that cause this phenomenon?
- What are the impacts of a market lag?
- What can be done to overcome market lags in investment in energy efficiency in buildings to avoid the worst impacts?

These are very difficult questions and we can only summarize the results of our investigation here. (Additional information is available in a forthcoming report by M.D. Levine.)[3]

In this section we shall discuss new homes in Figures 3, 4, and 7, and auto and commercial buildings in Figure 5.

New Homes

The first three questions are addressed for new residential buildings by the information presented in Figures 3 to 4, which apply to homes heated by gas and electric-resistance respectively. The top curve in Figure 3, with circles at 1972, 1975, and 1979 are average U.S. building practice on those dates, as surveyed by NAHB and translated into energy by computer analysis, using Lawrence Berkeley Laboratory's DOE-2 Computer program. Clearly, new homes are slowly getting thermally tighter.

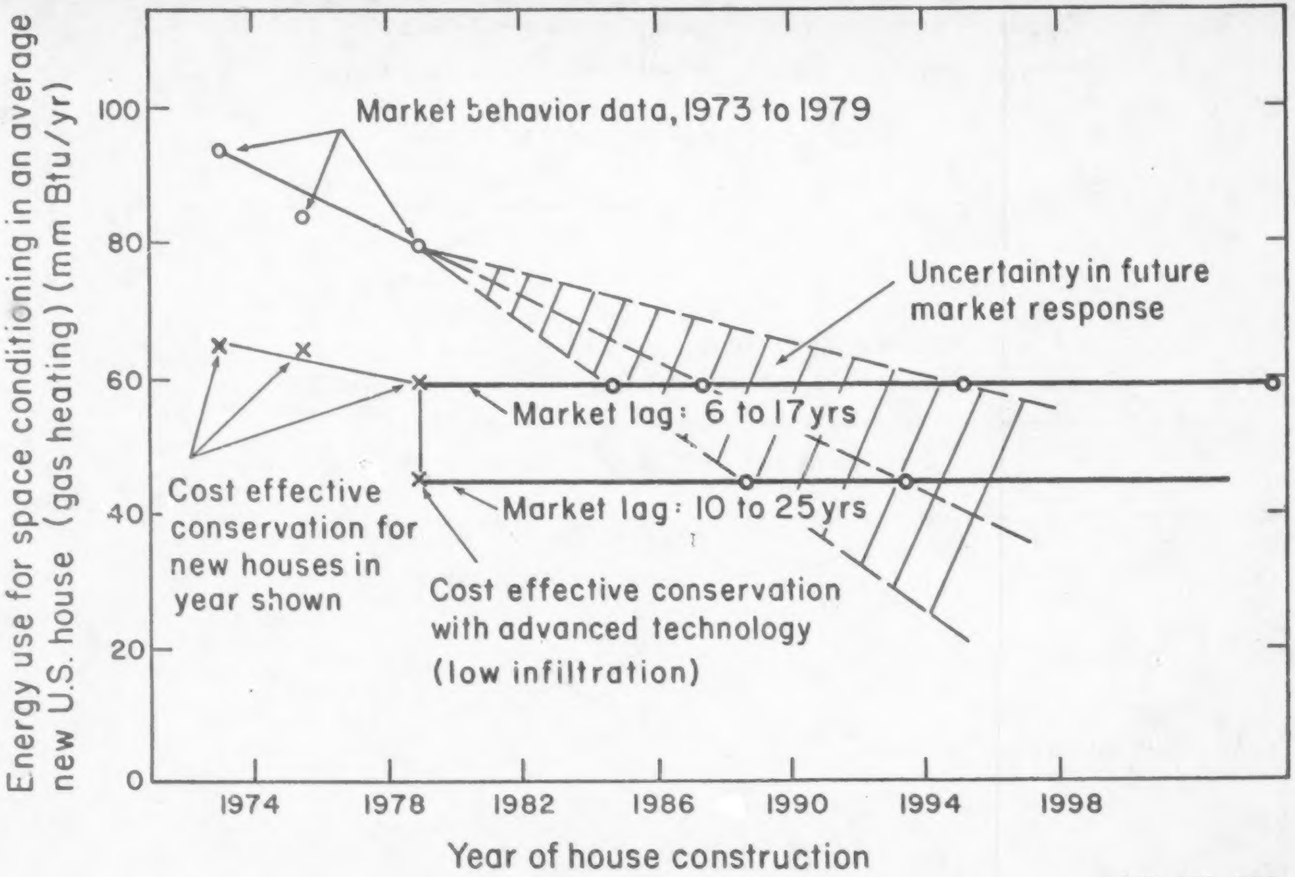
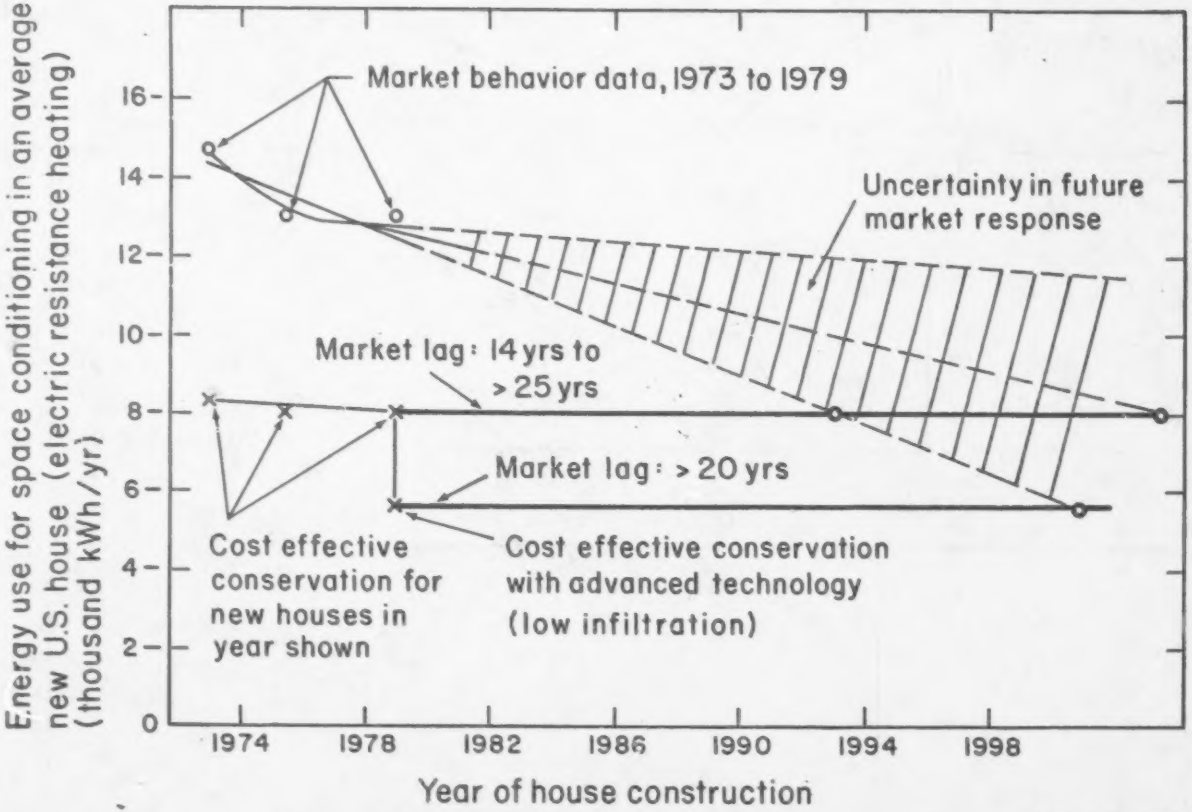


Figure 3. Market behavior and energy conservation in gas heated new houses in the U.S.*

* Based on LBL analysis of NAHB survey data on 300,000 houses constructed 1978-1979



XBL 813-507

Figure 4. Market behavior and energy conservation in electric resistance heated new houses in the U.S.*

* Based on LBL analysis of NAHB data on 300,000 houses constructed 1976-1979

The wedge starting at 1980 is our estimate of the uncertainty in projecting this trend. Additional research underway at LBL is attempting to narrow the range in this uncertainty. The lower curve, connecting the X's, represents the energy use by a simulated home built in the same years with all conventional cost effective conservation measures, using gas and electric prices for those years. We note that the homes with cost effective conservation measures use only about 2/3 as much energy as the real ones, and also improve with time.

Economists use a consumer discount rate to describe the shift between the prefect least-cost strategy -- the crosses in the diagram -- and the actual market decisions, the dots. The crosses assume the home-owner invests at a discount rate of 3% real, that is about 13% when present inflation is included. The "actual" dots correspond to a discount rate of 15% real.

Suppose we were to assume that fuel prices miraculously stopped rising after 1978-79, so the home with cost effective conservation in that year would also be the cost effective solution for the next decade or two. We then ask how long it takes the wedge to get down to this 1979 least-cost level. The answer is 6 to 14 years -- in other words, the length of time until our "projected market trends" (a very wide band) intersect the upper of the two horizontal lines.

The actual lag is, of course, longer than that, because new technologies will come in and pull down the least-cost line, and because energy prices will in fact continue to rise.

To illustrate the first point, we have introduced the concept discovered during the early 1970's of cutting the rate of natural infiltration of outside air with the use of a plastic vapor barrier with careful sealing of all seams -- and then restoring fresh air with mechanical ventilation through a heat exchanger. This technique adds about $400-700 to the cost of a new house, but saves at least 75 gallons of heating oil, or 100 therms of gas, each year. The lower X for 1979 shows this new cost effective technology with mechanical ventilation, and the horizontal lines labelled "low infiltration" projects that case into the future, again with no increase in fuel prices. In that case, the market wedge crosses the "low infiltration" line after 14 to 30 years.

Figure 4 illustrates the market response in houses with electric resistance heating. In this case, the lag is far greater than for gas heating, primarily because the higher price of electricity justifies much greater investment in energy efficiency improvements. The data show that the investment in energy conservation in houses with electric resistance is in fact no greater than in houses with gas heating, in spite of the greater payoff from such investment. Thus, the market lag in this case is at least 14 years (for the implementation of traditional conservation measures) and greater than 25 years (for low infiltration measures). To make matters worse, these lags are based on an optimistic assessment of market response (judging from past experience), and the lags could be very much longer unless there is a rather radical departure from past behavior of the market. The consumer discount rate corresponds to a surprising 40% real, equivalent to a 2 - year payback on the initial investment.

The reasons for the sluggishness of the market in investing in higher energy efficiency in buildings are not fully known. In our judgment, the most important reasons are the lack of highly reliable information on the costs and benefits of efficiency improvements easily available to the home buyer and home builder. The difficulty and high cost of obtaining reliable information means that decisions are often made with inadequate information. This appears consistently to lead to an underinvestment in energy efficiency; the difficulty in raising capital for houses tends to make the problem even worse, in spite of the fact that a cost effective investment in energy efficiency will lead to lower monthly fuel bill plus mortgage payments.

The economic impact of this underinvestment in energy efficiency is significant and adverse. If approximately 1.5 million new homes per year consume 30 million Btu each more than is economically desirable, this is an annual increase in the U.S. energy bill of $315 million, for residential space conditioning alone. These houses last many years, and the extra fuel costs accumulate year after year (unless the houses are later retrofitted, at costs often much higher than efficiency improvements in new houses). In fifteen years, the annual needless extra expenditure on energy for space conditioning just the new houses built in this time period is $4.7 billion, if the market fails to catch up with the optimum investment in energy efficiency.[1] In the more likely case (in Figures 3 and 4) that the market does continue slowly to close the gap between actual and economically desirable investment in energy efficiency in residential buildings, the annual extra fuel bills for space conditioning just for new houses built over the next fifteen years is in excess of $2 billion.

The foregoing discussion provides a rough but quantitative assessment of the problems of the market unresponsiveness and lags in residential efficiency investments.

Autos and Commercial Buildings

Having shown a lag of about 20 years for new residences, we turn our attention to autos and commercial buildings. We shall show that autos, under the pressure of mandates and foreign competition, seem to be responding in about 10 years. Commercial buildings also seem to be responding rapidly.

For cars and office buildings we have not done any simulation of optimum efficiency. Rather, we have simply plotted in Figure 5 the European competition, which is probably not optimized for least-energy-cost, but at least is closer than U.S. Products, as seen (for cars at least) by the success of foreign imports.

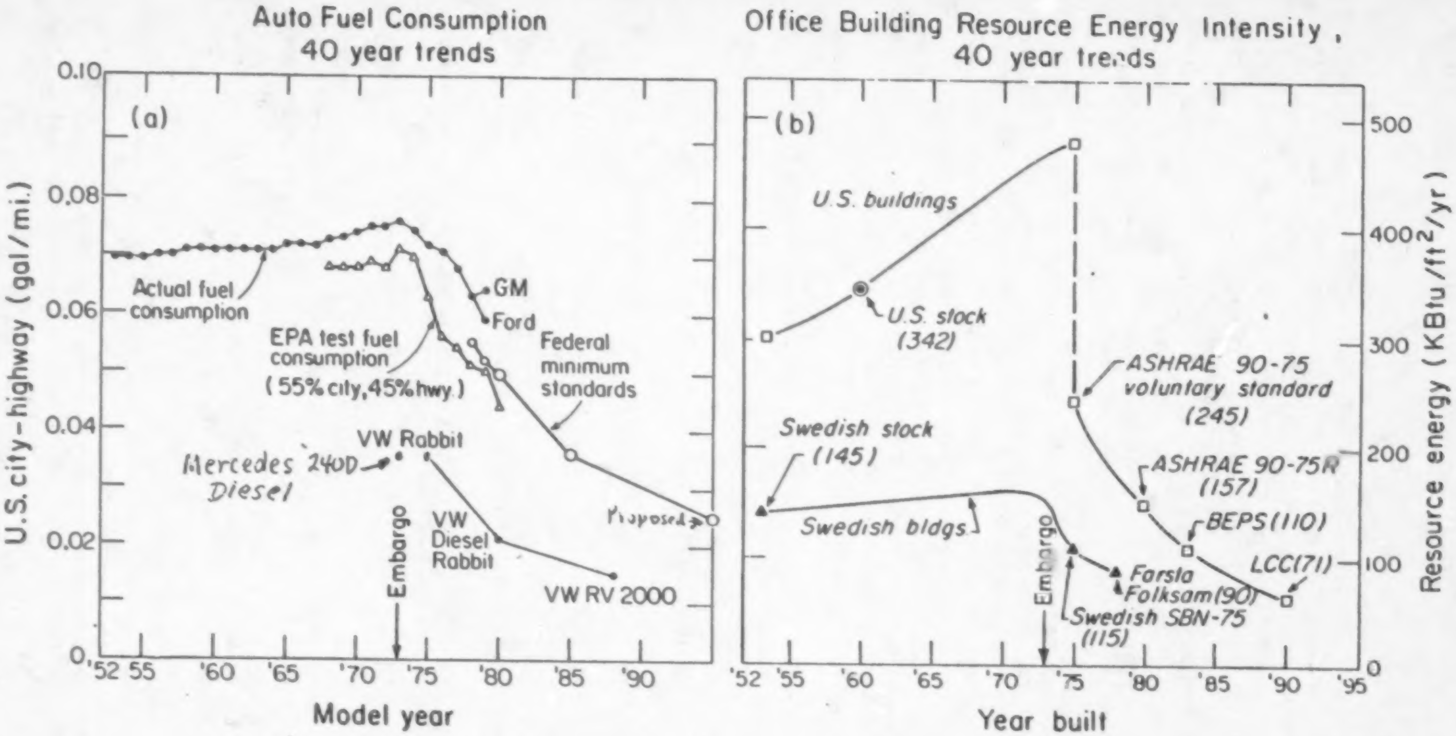


Fig. 5 Horsepower Race, Autos vs. Office Buildings. A 40-year perspective, measurements vs. calculations Sources: Society of Automotive Engineering Transactions, 750957; J. Pierce, 1975, Scientific American 232.1 (Jan 1975); F. von Hippel, 1980, "U.S. Transportation Energy Demand - Draft Report," (July 1980). Office Buildings: Energy Efficient Buildings - Draft Report, LBL 11300, EEB 80-6.

April 7, 1981

Note the similarity in shape of the two curves for cars; the top one labelled "Federal Minimum Standards" shows the target US new car fleet average: the bottom one shows some efficient European cars which are closer to the U.S. economic optimum. The US fleet average trails the optimum by at least 10 years, would trail more were it not for EPA miles/gal labels, and might have trailed even more were it not for the mandatory standards. It is interesting to note that the 1985 standard of 27.5 miles per gal. when proposed in 1975, was greatly influenced by the availability then of the Mercedes 240 D, which already achieved 28 mpg, and was judged to be acceptable to Americans and near the economic optimum.

Swedish buildings are heated with hot water from district heating systems at prices comparable with US fuel, or with electricity at prices comparable with U.S. electricity. The buildings would use the same amount of energy if they were at the economic optimum, but even the Swedish buildings are probably not yet at economic optimum. Even so they are about 10 years ahead of the U.S., under the optimistic assumption that U.S. buildings will economize as fast as would have been required by BEPS in 1985 and will reach by 1990 the life-cycle optimum design for 1978.

The remainder of this paper discusses the appropriate role of the Federal Government.

CATEGORY B1. INFORMATION PROGRAMS AND LABELS FOR CARS, APPLIANCES, HOMES, AND BUILDINGS.

After the 1973 oil embargo, the Congress imposed first a voluntary appliance labelling program, and then when that failed to produce very many labels, a mandatory labelling program, to be followed in 1981 by mandatory standards.

For buildings, labels were never considered, but mandatory standards were to take effect in 1981. Many utilities sponsor voluntary labelling, and Florida has a mandatory program.

Mandatory auto fuel economy labels took effect in 1975, and have been at least partly responsible for raising fleet miles/gallon from 14 in 1975 to 27.5 in 1985. The gasoline conserved by this doubled efficiency costs the consumer about 40¢ per gallon saved -- generally considered an excellent investment compared to the alternative of paying $1.40 per gallon purchased.

1. The case for labels.

Labels induce consumer confidence to invest in superior appliances, homes, and buildings, both for their energy savings during his ownership, and because the labels establish a resale value for the investment.

Example 2

PG&E's Energy Labels for New Houses

Edison Electric Institute's National Energy Watch covers many labelling programs. We describe here one with which we are familiar. It is inducing builders to invest about $375 for improvements which save 375 therms/year of resource[4] energy. This corresponds to a cost of conserved energy of 7¢ per therm saved,[5] i.e. about ten times cheaper than the "third tier" California price of gas and electricity. In 1977, California adopted a mandatory building energy code (Title 24) which is periodically updated, but is still far from a least-cost design. So Pacific Gas and Electric Co. awards "points" to builders for features beyond those mandated.

Under Title 24, a Northern California home uses about 400 therms annually for space heating, plus 300 for water heating, plus 8500 kWh of electricity (equivalent to 1000 therms of resource energy): total 1700 therms.

Each PG&E point corresponds to an annual saving of 3 therms (or 30 kWh). To qualify, a builder must reach a threshold of 50 points. If he chooses to go beyond this threshold, PG&E will so certify and pay him $2 per additional point. PG&E's experience is plotted in Figure 7.

Builders have discovered that Energy Conservation Homes are popular and sell fast, so 60% of all new "connects" now qualify, and the average number of points is 75, i.e. 25 beyond threshold. This is a potential savings of 225 therms (13%). One large builder, Presley Homes, advertises 150 points (450 therms, i.e. 26% better than Title 24). For comparison, PG&E estimates that even the average non-qualifying home is now 25 points (4%) better than Title 24. A sample score-sheet is attached, filled out to show how a builder can reach 125 points (one therm/day) for $375.

Inspection. Before awarding the certificate and $2/point incentive, PG&E representatives inspect between 10% and 100% of the new homes. This service is popular with builders because the inspection often uncovers poor work by subcontractors.

PG&E has surveyed owners of Energy Conservation Homes. They respond that the homes are comfortable, and feel, on average, that the features they purchased are worth $800, to them as owners, and at the time of resale. This is an interesting clue that the market can recognize energy efficiency in labelled homes, just as it now places a high value on energy-efficient cars.

The PG&E program has been judged so successful that a form of it will be taken over statewide by the Calif. Public Utilities Commission in July 1981, and tied to the California "line-extension credit plan."

Conclusion.

The present authors agree with President Reagan that decontrolled energy prices will lead naturally but slowly to more efficient buildings. But credible labels are a dramatic aid to market forces, and will advance the market response by many years. In its haste to abolish mandatory standards for appliances and buildings, the administration should not overlook labelling, and should provide the appropriate tools and infrastructure.

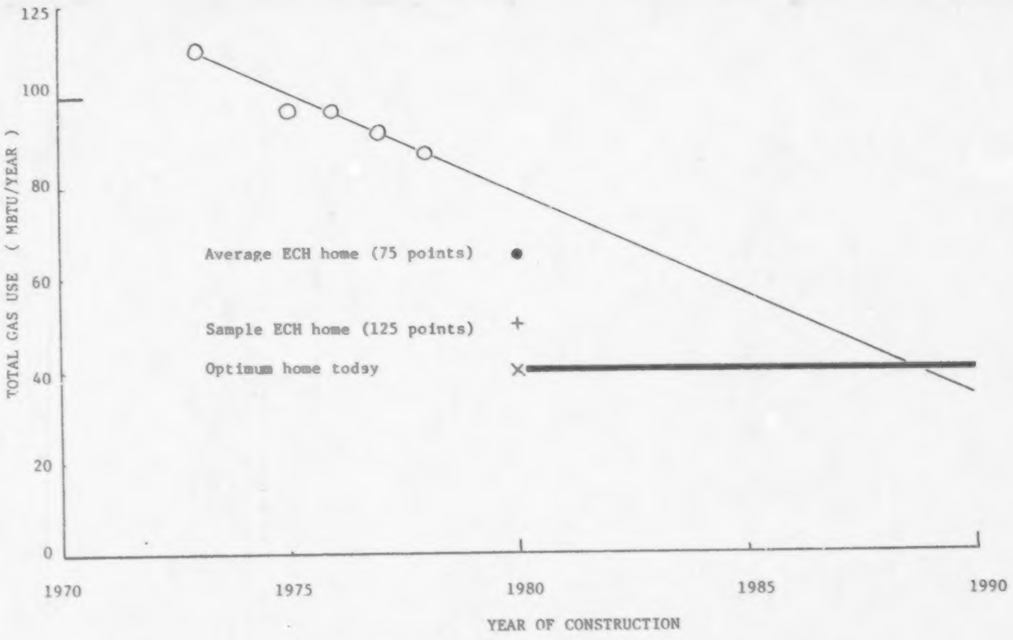


Figure 7. Total use of gas in new gas-heated homes supplied by Pacific Gas and Electric Company in Northern California. Open circles are average billed use of gas for homes built in the year indicated. The solid dot is the calculated gas use of the average home qualifying in 1980 as an Energy Conservation Home; 60% of all new homes qualified. The " + " is the sample Energy Conservation Home marked up on the score sheet at the end of this report (125 points, i.e. 375 therms, for $175). The " x " is the estimated use for a home built today in Fresno's climate that minimizes its lifetime costs. Presley Homes currently advertises that its homes are as good as least cost. The thick horizontal line is the economic optimum energy use, on the assumption that gas and gas conservation costs remain constant in real dollars. This figure is in the same format as Figures 3 and 4, except that the points are actual metered gas use, instead of being estimates based on building plans.

April 7, 1981

Thus labels strengthen the market for efficient products, and help the conscientious manufacturer and builder.

To be effective, the labels need not be mandatory, but they must be widespread, so that comparison shoppers can find them, and avoid unlabelled appliances and buildings.

And to be effective, they must be credible, accurate, and verified, at least by spot checking. Roughly one third of auto workers are assigned to quality control; it is clear that some small fraction of new buildings should likewise be tested for thermal efficiency and indoor air quality.

2. Proper role for the Federal Government.

For cars and appliances, there is general agreement that labelling is best handled at the national level. But homes and buildings are tailored to local climate and energy supplies and prices, so labelling programs can best be handled by states or utilities.

But a labelling program requires the following tools, which, because of economy of scale, are most efficiently provided by the Federal Government. These standard tools include:

a. Research programs to calculate the optimum sequence of options to get from current building practise to least cost, based on lifecycle economics.

b. Calculation of "Conservation Score Cards" and Manuals of Recommended Practise.

c. Development of equipment and procedures for testing thermal integrity, air and duct leakage, HVAC (heating, ventilating and air conditioning) systems, and indoor air quality.

To show that states and utilities need some federal help in formulating residential energy labels, we cite the fact that both Florida and California have labelling programs, yet neither state had enough information to include credit for low infiltration, even though this is the single most cost effective measure, and neither state has the resources to organize a field monitoring program to validate the labels.

3. Savings by Reducing the Consumer's Discount Rate

The discount rate implicitly used by the homeowner to decide whether or not to conserve may be very high; the earlier analysis showed that for new California homes it may be 40% above inflation for electrically heated homes, 15% above inflation for gas heated homes. The impact of these high rates may be estimated as follows:

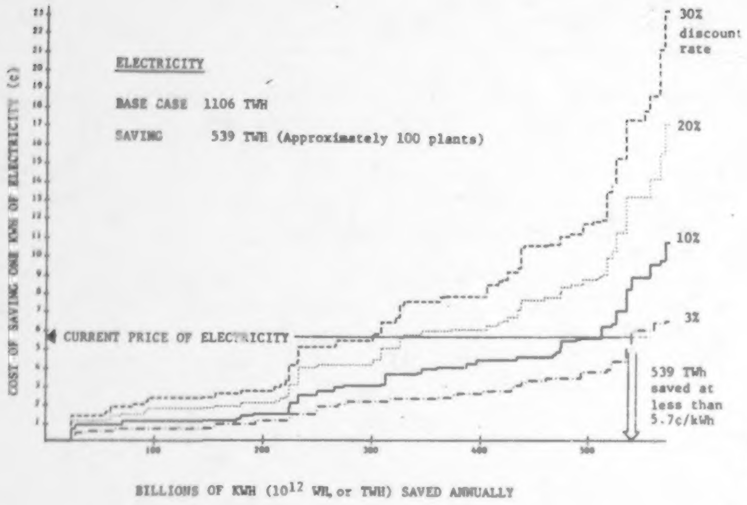


Figure 6(a) Supply curves of conserved electricity for the US residential sector (retrofit of stock, plus 20 years of construction) in the year 2000. Four curves are plotted, each corresponding to a different real discount rate. LBL-11300

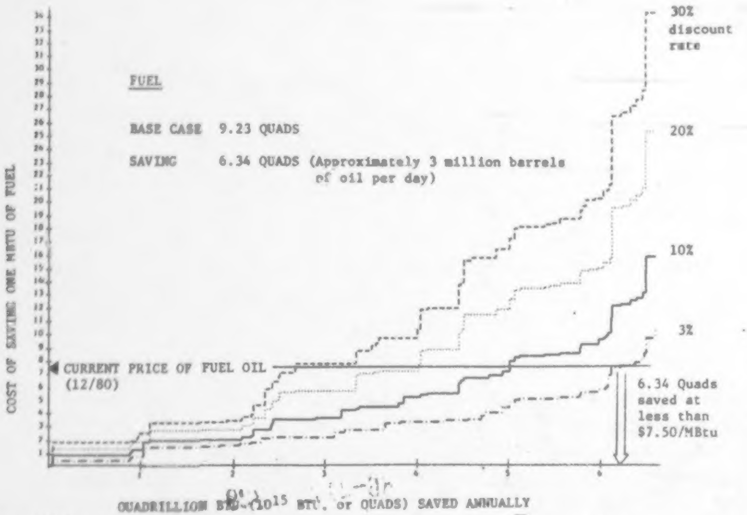


Figure 6(b) Supply curves of conserved fuel for the US residential sector (retrofit of stock plus 20 years of construction) in the year 2000. Four curves are plotted, each corresponding to a different real discount rate. Source: LBL/SERI Buildings Study, LBL-11300, April, 1981.

Figures 6(a), 6(b) are "supply curves" of conserved energy for U.S. residences in 2000 AD. The curve indicates how much it would cost to save a given amount of energy. Implicit in the calculation is a discount rate. The rate used by different homeowners will vary; the higher the market imperfections drive the consumer discount rate, the lower the available conserved energy will be for any given energy price. To illustrate this effect, let us look at the effect of going from a 20% real discount rate to a 3% real discount rate for fuel conservation. At a 20% rate and fuel for $7.50/MBtu, the homeowners would invest in conservation up to 4 quads. If all the market imperfections were corrected, the homeowner would invest up to 6.3 quads, saving more energy and more money. The picture for electricity is similar; savings in 2000 are 320 and 540 TWh respectively. Although these numbers are only illustrative, it is clear that there is great potential to reduce U.S. expenditures on energy by reducing the discount rate that the consumer perceives.

We contend that a federal infrastructure of research, labelling information, test and inspection procedures would achieve this aim, and that such a program would be high pay-off, anti-inflationary, and wise.

April 7, 1981

CATEGORY B2. RESEARCH THAT SPEEDS THE MARKET, BUT IS NON-CAPTURABLE AND NON-PATENTABLE

As an example of this common type of research, we site the development of the "blower door" by Princeton and NBS, and the use of this technique to discover the importance of attic bypasses and to pioneer the whole field of House Doctoring.

Over the next few years, thousands of house doctors will use relatively primitive tools (window fans to pressurize a home, "punk" to smoke) to detect and plug air leaks. The fruits of the research are a new trade, but there is no way for the developer of the technique to patent his findings.

Example 3

Fan Pressurization Detects Air Leakage

Air leakage is expensive. In the US, the natural infiltration of outside air into houses causes, on the average, a complete change of air every one and a half hours; this is called 2/3 air changes per hour, or 2/3 ach. To heat this air all winter takes 200 gals of fuel oil or 250 therms of gas.

In 1975 the CEES at Princeton University under Professor Socolow started to investigate methodically the sources of this infiltration, since leak plugging seemed an obvious and cheap way of cutting home heating bills. They caulked windows and weatherstripped doors, but found that they had hardly reduced infiltration at all. This was amazing, since all engineering manuals showed windows and doors to be the major sources of infiltration.

To find where the leaks really were they developed a "blower door", a replacement front door with a fan set in it. Using this door they blew air into houses and traced where it leaked out; the tools they used were simple smoke sticks and expensive infra-red cameras. They found that the major leakage sources in houses included gaps where pipes enter walls and ceilings, gaps around recessed light fixtures, dropped ceilings above bathtubs, and built-in cupboards. They also discovered that the spaces inside both interior and exterior walls can act as a chimney, leading warm inside air to the outside. They called all these newly discovered leakage sites "bypasses", since they bypass insulation.

This discovery explained why insulation often performed far below expectations; the warm air was simply going around it. Therefore the bypasses must be fixed before you insulate. The Princeton researchers have shown that a two-person team of "house-doctors", trained in the use of the blower door and infrared camera, can reduce air leakage by 20% to 40% in half a day's work.

Researchers at Lawrence Berkeley Laboratory have developed a model that related the pressures and flow rates obtained from the blower door to infiltration rates. The air leakage is expressed as an area, a measure roughly equivalent to the sum of the areas of the individual leaks. For example the equivalent leakage area of a typical house is approximately one square foot - roughly the same as a two inch high opening of two 3 ft. wide windows on opposite sides of the house. Retrofitting reduces the leakage area. The LBL model predicts the reduction in infiltration is proportional to reduction in leakage area. Thus the 20% to 40% reduction seen by house doctors on the East and West coasts translates into a saving of 75 gals of fuel oil, or 100 therms of gas. On a national basis, that becomes half a million barrels of oil a day, or $5 billion a year.

Further savings can be obtained by fixing leaks in air ducting. Both LBL and Princeton have found that as much as 20% of the hot air fed into ducts leaks out into unheated attics and crawl spaces. The same has been shown to be true for cold air in central air-conditioning systems.

The parallel efforts at Berkeley and Princeton have shown an interesting effect: house doctoring seems to be just as cost effective in warm climates as in cold ones, though the precise measures are sometimes different. It should be noted that the research which has led to the identification of the ways to save $5 billion a year cost the Department of Energy a mere $1 million a year.

April 7, 1981

CATEGORY B3. DEVELOPMENT OF NEAR-TERM TECHNOLOGIES.

CASE a) No US Manufacturer Exists.

Hirst et al.[1] present as exhibit No. 12 Electric Heat Pump Water Heaters. Two more examples are gas-fired heat pumps and residential air-to-air heat exchangers.

In the case of the heat exchangers, no US manufacturer is yet in production, but LBL set up a test facility in 1978. We tested the foreign models and found one that was not suited to severe American / Canadian winters. These tests helped pioneering builders of energy efficient homes to choose the appropriate units.

When the first American prototype arrived in 1980, it worked badly, but we were able to suggest modifications which were quickly adopted by the manufacturer, who now plans to become the first US producer.

CASE b) Industrial Inertia.

There are cases where large manufacturers, quite capable of introducing an innovation do nothing because no single manufacturer wants to "shake the boat". An example was the high-frequency fluorescent ballast, described in our last example.

Example 4

Mechanical Ventilation and Heat Exchangers for New Homes

To assure good indoor air quality, homes should probably have about 2/3 of an air change per hour (ach). We have mentioned several times in this report that to heat 2/3 ach all winter takes 200 gallons of fuel oil, or 250 therms of gas.

If new homes are built with a carefully installed vapor barrier, natural infiltration is reduced to about 1/10 ach, and can be replaced with mechanical ventilation through a heat exchanger with an effectiveness of about 75%. Such devices retail from $250 for a window model (the price should come down with mass production) to $500 for a central unit. They use only 50 to 150 watts of electric power, and save over 100 gallons, perhaps 125 therms, per year.

By 1990, we should have at least 10 million new dwellings. We consider the savings from heat exchanger both in winter and summer.

In winter the savings is 15 million Btu x 10 million homes = 0.15 quad, worth nearly $1 billion per year, about 3 million per day.

In summer, a water-permeable heat exchanger can turn around outdoor water vapor as well as outdoor heat, and it is the water vapor that puts 2/3 of the load on an air conditioner in the humid southeast of the U.S. A permeable exchanger can save about 1/2 kw of peak power in the warm, damp parts of the U.S., where perhaps 2.5 million new homes will be built by 1990. That represents an additional savings of 1.3 GW of peak power, which costs our utilities about $1 per installed watt. The capital savings is then another 1.3 billion.

The federal effort so far in heat exchanger testing facilities has cost less than $1 million. For every year that full market acceptance of heat exchangers is accelerated, the nation gains $100 million. This is an excellent rate of return on a modest federal investment.

Example 5

HIGH-FREQUENCY SOLID-STATE BALLAST FOR FLUORESCENT LAMPS

There are two ways in which the efficacy of fluorescent lamps can be improved. First, it has been known since 1950 that if the lamps are driven at high-frequency instead of 60 HZ power from the utility, their lumen output per watt (efficacy) improves 15%.

Secondly, for every 100 watts input into a typical conventional fluorescent fixture, 16 watts goes to heating the steel and iron "ballast" and never gets to the lamp.

By the late 1970's, advanced electronic technology made it possible to design a solid-state high-frequency oscillator which could power the lamps and have internal losses of only a few watts instead of the typical 16 watts. The lamp becomes more efficient because it does not turn off every half a cycle at the high frequencies (no flicker) and the ballasting is done at high frequencies which use smaller components that have less heat losses. The combined savings for a typical 100-watt fixture are then 10 watts from the ballast and 15 watts from the lamps, totaling 25 watts. As to price, the normal ballasts cost about $6.00 wholesale, and tend to be noisy; the new ballasts will sell for about $20.00; both sorts last about 15 years.

The favorable economics for each lamp are as follows: over 15 years, the extra $14 investment will save 1300 KWH, worth about $65.00. Using a 10% real interest rate (in constant 1980 dollars) the cost of conserved electricity is 2.1 ¢/KWH, much cheaper than the average commercial-sector price of [illegible] ¢/KWH. In addition, the new ballasts are capable fo continuous dimming, both to take advantage of daylight, and to keep a constant light level on the task below as the lamps degrade with time.

If economics (2.1 ¢/KWH) are so favorable, one wonders why the lighting industry waited for a federal incentive program, or how much this program advanced the inevitable development.

The ballast industry is very similar in structure to other sectors of the lighting industry, namely a very stable industry dominated by four to six large companies with many small companies comprising a very small percentage of sales. Because of the structure of the industry and the relative stability of the market share, it is very difficult for small companies to infiltrate the marketplace and be competitive. There is also little incentive for the large companies to rapidly innovate new technologies, especially when the innovation will require substantial investment on their part, since the results will probably be duplicated by the other companies at less cost, and market shares will not change drastically.

Box continued on next page

Example 5 (cont'd.)

Looking for cooperation with industry, LBL issued a competitive request for proposals four years ago to develop a solid-state ballast that would improve efficiency by 25%, offer continuous dimming capability, and be lighter/smaller in size. The large ballast companies not only refused to respond to the request for proposals, but published many statements that solid state ballasts would never make it due to first cost, technical problems, adverse affect on lamps, consumer acceptance, etc., etc. The LBL program worked with two small contractors to develop and test solid state ballasts. As a result of the successful tests, a large corporation, Beatrice Foods, purchased the rights to one of the ballast designs, conducted a large demonstration (cost-shared with DOE) of the ballasts, constructed a manufacturing plant, and is now taking orders for solid state ballasts. Since Beatrice Foods has the funds to impact market shares in the ballast industry, all companies were forced to reevaluate their position. Recently, seven manufacturers have announced the development of an energy saving solid state electronic ballast. At least two of these seven are large ballast manufacturers that did not respond to the original request for proposals. Total expenditure of public funds in this area has been less than $1.5M and the results have been the availability on the commercial market of a solid state ballast for fluorescent lamps and the acceptance by the ballast industry of this new energy saving technology.

In 1980 the electronic ballast systems were assessed for total performance; that is, we considered all of the improved attributes of the electronically ballasted system--the tighter system control brought about by improved voltage regulation, the regulation of light output, and the ability to dim lamps, in addition to the 25% "intrinsic" improvement in system efficiency. Among our findings, now being compiled for publication as an LBL report, we demonstrated that total energy savings can be as high as 40-70%.

Finally, we note that at present the U.S. consumes annually about 220 x 10^9 KWH in fluorescent lighting.* A market penetration of 25% with a 35% improvement in efficiency at .05 per KWH results in annual savings to consumers of $1 billion--not bad for a total DOE catalytic investment of $1.5 million!

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* At 5¢/kWh, this costs more than $10 billion a year, or twice the entire non-military, non-strategic petroleum reserve budget of DOE.

April 7, 1981

REFERENCES and NOTES

1. E. Hirst; W. Fulkerson; R. Carlsmith; T. Wilbanks; "Improving Energy Efficiency: The case for Government Action"; Oak Ridge National Laboratory, March 1981.

2. D.M. Moschandreas; H.E. Rector; P.O. Tierney; "A Survey Study of Residential Radon Levels," Geomet Technologies Inc. Report ES 877 to LBL Jan. 14, 1981.

3. M.D. Levine and J.E. McMahon; "Residential Energy Conservation and Market Behavior," LBL report in preparation.

4. To calculate the cost of conserved energy, we assume that the homeowner finances his investment in efficiency via a 20 - year loan at a real interest rate of 3% in 1980 dollars, and no fuel price escalation beyond general inflation. This corresponds to a capital recovery rate of 6.7% per year.

5. The resource energy associated with 1 kWh of electric sales is 11,500 Btu burned back at the power plant.

April 7, 1981

Appendix A

Improving Energy Efficiency: The Case for Government Action

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March, 1981

TABLE OF CONTENTS

Page

Introduction 1
Barriers to Conservation 8
The Role of Government in Improving Energy Efficiency 17
Conclusions 31
Bibliography 33

Exhibits:

1. Improving U.S. Energy Productivity: The Least-Cost Strategy 4
2. Benefits to the Nation of Improved Energy Efficiency 5
3. Obstacles to Rapid Adoption of Energy Conservation Options 8
4. Retrofit Potentials at Institutional Buildings 11
5. Household Retrofit Actions: The Need for Government Programs 12
6. Market Failures Associated with Energy Efficiency of New Homes . . . 14
7. Changing Patterns of U.S. Energy Consumption 15
8. DOE's Low Cost/No Cost Energy Conservation Program 19
9. The RCS Model Audit: An Example of Technical Assistance 20
10. Federal Energy Efficiency Standards: New Car Fuel Economy 22
11. TVA's Home Insulation Program 23
12. Heat Pump Water Heaters: A New Technology 25
13. Industrial Low-Temperature Heat Utilization 26
14. The Annual Cycle Energy System 27
15. Estimated Benefits of Government Programs 29

Appendix B

ENERGY
CONSERVATION
HOME PG&E

ENERGY CONSERVATION HOME REQUIREMENTS AND AGREEMENT

For Individual or Multi-Family Dwellings

Pacific Gas and Electric Company

ENERGY CONSERVATION HOME PROGRAM
for Individual or Multi-Family Dwellings

Standards for Qualification

I. **General**

The purpose of these requirements is to improve the energy performance of residential dwellings.

II. **Minimum Standards**

A. To qualify as Energy Conservation Homes, dwelling units will be rated by a scoring system with points determined by the potential for annual energy savings of three therms of gas or 30 kilowatthours of electricity. Actual savings may be higher or lower depending on individual operation and locality. One point is also given for each 2,000 gallons/year of water savings.

B. All gas and electric appliances incorporated in the dwellings are to be approved and/or certified by the American Gas Association and/or the Underwriters Laboratories.

C. Qualification procedure will be as follows:

1. PG&E customer.
2. Minimum number of points per dwelling will be: . . . . 30 points

D. The partial list of energy conservation systems and devices which follows includes alternatives to be considered in the construction of dwellings to Energy Conservation Home standards. Unless otherwise specified, points will only be allowed *once* for any feature, AND WILL NOT BE ALLOWED FOR FEATURES MANDATED BY STATE OR FEDERAL CODES.

A builder may desire to incorporate other energy conserving features in lieu of those listed or may wish to make a specific points calculation for listed items to fit the particular climate zone. See Paragraph II-A when making such calculations. Figures are subject to PGandE verification and approval.

MEMBER
NATIONAL ENERGY WATCH

	Points Allowed	Score	Incremental cost ($)
(1) Major Appliances:			
Gas Range	13	13	-
Oven with light and window	1		
Microwave oven	10		
Dishwasher with switch controllable drying cycle	5		
Gas dryer outlet	10	10	25
(2) Space Heating/Cooling			
Set-back or programmable thermostat (not for use with heat pump)	16	16	60
Clogged filter indicator Used with air conditioning	8	8	20
Air conditioning - 1 point per 0.1 increment in EER exceeding state requirements. Points will only be awarded in areas where air conditioning is required as defined in PGandE Schedule D-1.	10		
Solar Assisted Space Heating System: One point will be awarded for each 2 square feet of properly located (orientation and tilt) collector			
(3) Water Heating:			
Insulation blanket	5	5	25
Solar Assisted Water Heating System: One point will be awarded for each square foot of properly located (orientation and tilt) collector			
Insulated hot water piping first four feet from water heating unit	2	2	15
Insulated hot water piping throughout	5		
Showerheads with flow-control devices rated at 2½ GPM or less	4	4	10
(4) Weatherization:			
Caulking (per 1,000 sq. ft. of floor area) (Assume a 1,500 sq ft house)			
-- Exterior sole plate only	7		
-- Seal all plug outlets only	4		
-- Total exterior (doors, windows, electrical/plumbing penetrations, sole plate, top plate, plug outlets)	23	35	200
Ceiling R-30 (per 1,000 sq. ft. of floor area)			
Heating benefit	5		
• Cooling benefit	2		
Walls R-19 (per 1,000 sq. ft. of wall area)			
Heating benefit	7		
• Cooling benefit	4		
Perimeter insulation for slab on-grade floors with moisture barrier (per inch of insulation thickness exceeding state standards)	12		
Conventional floors (per 1,000 square feet)			
– R-19 instead of R-11	2		
– R-11	10		
Double glazing (per 25 sq. ft. window area)			
Heating benefit	3		
• Cooling benefit	1		
Thermal drapes, moveable insulating shutters, blinds, roller shades, integral louvered screens or other glazing insulation features (per 25 sq. ft. window area)			
Heating benefit	2		
• Cooling benefit	1		
Reflective glass or film on east or west facing glazing (per 25 sq. ft.)			
• Cooling benefit	4		
Subtotal		93	$355

•Points awarded only in areas where A/C required – see (2).

	Points Allowed	Score	Incremental cost ($)
Insulated exterior doors (per door)			
– 2" wood, solid core	1		
– 1¾" with solid polystyrene core and thermal break	1		
– 1¾" with solid urethane foam core and thermal break	3		
Attic ventilation (* cooling benefit only)			
– Eave vents with continuous ridge vent	4		
– Eave vents with gable vents	2		
(5) Chimney (fireplace):			
Positive damper, without gas outlet	3	3	-
Fireplace – Glass doors	5		
– With heat exchanger	6		
– Connected to central space heating ducts	5		
– With outside combustion air supply (dampered or used w/glass doors)	2		
Free-standing model	10		
Air tight wood burning stove	20		
(6) Lighting:			
All incandescent and fluorescent fixtures surface mounted	2	2	-
Fluorescent Application:			
– Exterior - Porch/Patio	3		
– Kitchen area	5	5	-
– Laundry area	1		
– Bathrooms (all)	7	7	20
– Bathrooms (full only)	5		
– Recreation or family room	3		
– Shop or garage	1		
(7) *Passive Solar Design Features:*			
Heating Benefit:			
House to lot orientation (minor axis within 25° of true south)	*15*	15	- *
South facing glass in excess of 25% of total glazing area (per 3 sq. ft.) (Where glazing exceeds 22% of floor area of room being passively heated, room must be protected from excessive heat gain)	2		
Evergreen trees providing protection from prevailing winter winds on north, northeast or northwest exposure (per tree, 15 gal. minimum if newly planted)	*1*		
Cooling Benefit:			
Deciduous trees providing summer shade on west, east, or south facades (per tree, 15 gal. minimum if newly planted)	2		
Roof overhang or operable exterior awnings on south exposure for each 2 inches exceeding 12 inch horizontal overhang (maximum 32" overhang)	*1*		
(8) *Active Solar Design Features (for future adaptation):*			
Increased slope on south-facing roof (minimum unobstructed roof surface 8 ft. x 8 ft. with required structure to support future solar panels) (per each 5° over 25° slope, 40° maximum)	2		
Rough plumbing for future solar hot water retrofit (must include 2' x 2' minimum space and stubbed control valves for future hot water storage tank)	5		
(9) Other			
TOTAL POINTS		125	$375

* Can account for extra costs due to site constraints or poor planning

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BUILDING ENERGY LABELS

For New and Existing Residential and Commercial Buildings

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Energy Efficient Buildings Program
Lawrence Berkeley Laboratory

June 18, 1981

I. Overview

II. New Buildings

   A. Single-family residential

   B. Other buildings

III. Existing Buildings - Connection with RCS Audits

IV. Indoor Air Quality

V. Monitoring and Analysis

A FEDERAL INFRA-STRUCTURE FOR VOLUNTARY BUILDING ENERGY LABELS

I. Overview

For automobiles we have adopted both mandatory fleet average fuel economy standards and individual EPA mpg stickers. The CAFE standards guaranteed a market for more efficient cars, and hence induced the manufacturers to invest in new assembly lines, but it has been the individual stickers which have bestowed a high value on efficient cars, both in the new and used car markets.

For appliances, California has a successful program of both mandatory standards and labels, but the Reagan Administration favors mandatory labels only.

For buildings, we have been following a different and inconsistent path leading to standards only. This is probably because until recently we had little faith that we could predict the energy use of a home or commercial building, and did not realize that labels would be popular and credible with purchasers of new and existing homes and buildings.

In the last few years, several utilities have adopted voluntary labelling schemes for new homes, and builders have discovered that the labelled energy-efficient homes sell faster and command a higher price. Florida has a successful labelling program.

Unfortunately these labels do not all use the standard units of therms-or-gallons, kwh, and dollars; some use "points" of various denominations, probably because realtors and financiers have long used such "points".

Since BEPS has run into opposition both in Congress and by the Reagan Administration, it is now urgent that the Dept. of Energy set up Building Energy Labelling System ("BELS"), which could then be adopted on either a voluntary or mandatory basis by states, local governments, or utilities.

A BELS study should suggest

- a methodology for calculating energy use and cost
- a format for the labels themselves
- procedures for storage and retrieval of the information
- tools and instruments for quality control
- tools and instruments for monitoring the accuracy of labels.

Adoption could be any combination of voluntary and mandatory. Thus a state might require labelling of new buildings, and, as they are retrofit, the following classes of residences:

- multi-family dwellings, which have proved almost immune to market forces because of the conflicting interest of landlord and tenant; (the thought here is that mandatory labels would make the market work slightly better).

- home retrofit with the help of public funds, e.g. the weatherization program, or substantial loans from the Conservation and Solar Bank.

- public housing, because energy costs are particularly important and troublesome for the needy.

I return to the Guidelines which would emerge from a BELS study. The Guidelines would suggest where the label is to be posted and how the information is to be available. I suggest two places, both in the home (e.g. on the furnace), and stored with the utility (whence both realtors and buyers can request it) for the following reason:

The Rating Game.

I suggest that once any building is labelled, the utility offer the following service, free, or for a small fee. On request, each residential monthly bill should be accompanied by an extra rating sheet, tabulating or plotting for the last 12 mo. three fuel and three electric quantities:

a. average use by the community
b. standard use for the home as labelled, corrected for weather
c. actual metered use.

Just as miles per gallon have become a familiar and reliable yardstick for owners and purchasers of cars, so, with the **help** of the monthly rating sheet, two scales, (e.g. gallons/month and $/ month) can become familiar and reliable for buildings.

Our example was for homes, but should be extended to commercial buildings too.

II. NEW BUILDINGS

A. Single-Family Residential

As mentioned above, new homes are the easiest to label, since building plans have to be approved by a code official and a utility before a new building is connected to gas and electricity.

As mentioned above, Florida has a labelling system, and the Pacific Gas and Electric"Energy Conservation Home" labels have become so successful that the State of California is discussing taking them over and tying them to utility line extension credits.

Unfortunately the present labels are not uniform, either as to what measures are credited, or in units. Federal help is needed to establish procedures to measure reduced infiltration air leakage from ducts, and credit mechanical ventilation through heat exchangers, for indoor air quality, and for ways to credit solar heat gain. We note that even such energy conscious states as Florida and California did not know how to give credit for reduced infiltration and have no procedure for quality control or monitoring the accuracy of the labels.

B. Other Buildings

Since multi-family and commercial buildings have more complex HVAC systems and schedules, the calculation and validation of labels is more expensive per building, but not per dollar of utility bill. BELS research can determine the cost-benefit trade-off for extending labelling to commercial buildings.

III. EXISTING BUILDINGS--CONNECTION WITH RCS AUDITS

Residential Audits under RCS should be slightly modified in contemplation of voluntary labelling, so as always to give a standard use of fuel and electricity, in addition to lists of recommended retrofits.

Any label generated by an RCS audit must show which of the retrofits was implemented, and there must be an updating proceedure for incorporating future retrofits.

Once a home-owner is assured that his investment in a recommended retrofit can be recognized when his home is sold, he will be more inclined to invest in upgrading his home.

IV. INDOOR AIR QUALITY

In the next few years, millions of new homes, and some homes in pockets of the US where there are problems with radon in soil gas, will have to be surveyed for indoor pollutants; organics, combustion products, and radon. BELS research must address the question as to whether these data should become a part of the house records, on the label, and in the records of the utility.

V. MONITORING

A. Analysis

Under BELS there will soon be data on millions of homes, permitting comparison between predicted and actual energy use. Analysis of these data can greatly enhance public confidence in the labels, and thus make the market work better. The analogue is the comparison of EPA sticker miles per gallon compared with on-the-road measurements. It is now generally accepted that the fuel efficient cars are about 10% worse than indicated by the sticker, and real but less efficient cars are about 5% worse, but the stickers give the right rank-ordering.

The proposed utility data on real and labelled bldg. energy use will not only demonstrate the reliability of the labels, but will point out areas of inaccuracy (e.g. perhaps in solar gain or thermal storage).

The BELS study must provide procedures for updating the labelling calculations.

B. Quality Control

We know of no State or trade association which currently monitors the thermal quality of buildings and provides feedback to builders and contractors. However, the California Energy Commission has indicated its intent to purchase an ENDAQ Van (Energy Diagnostic and Indoor Air Quality) and make it available to utilities and to the California Building Industries Association to monitor both retrofit and new home quality. DOE, under BELS, should provide plans and advice and cost sharing for the acquisition and operation of such survey facilities.